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ACID INTOXICATION: ITS SIGNIFICANCE IN SURGICAL CONDITIONS.

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THE condition of acid intoxication observed in surgical cases has been brought forcibly to our notice, during the past year, by a series of cases occurring at the Boston Children's Hospital and Boston City Hospital. In the present article I wish to call attention to those occurring at the latter hospital during my service as house surgeon. I am indebted to the members of the surgical staff, in whose services these cases were observed, for their kind permission in allowing me to report this series.

In a review of the literature of the subject I find series of cases reported by various writers which I feel sure are identical with those I am about to report. While they have been reported under other headings, they have been practically identical in clinical signs and results with those observed at the Boston City Hospital, and, while the mortality in the latter series has not been so great, there is no doubt but that they represent but one disease. While I do not pretend to explain the cause of the condition found in these cases, I feel sure that by presenting this series, I will contribute to a subject which will

eventually receive most careful attention in medical as well as in surgical cases, and perhaps stimulate to some extent physiological, clinical, and pathological investigation in this most interesting subject.

While not claiming that the term acid intoxication definitely describes the condition present, I feel that it will serve until the etiology of this puzzling disease has been definitely determined. Under this term are to be included all those cases which have been reported under the headings of Acetonuria, Acetonæmia, and Aciduria. In presenting this series there has occurred some clinical evidence of the existence of a form of acid intoxication which is apparently due to some disturbance in the body metabolism, and all the cases present in the urine acetone and diacetic acid, either separately or together.

This report is based upon the observation of about 400 surgical cases during a period of four months. The urine of these cases was examined (1) immediately upon entrance to the hospital; (2) within twelve to forty-eight hours after the administration of a general anæsthetic; (3) if at any subsequent time clinical signs suggested this condition, or the urine showed the presence of acetone or diacetic acid; and (4) the urine was examined in most cases every other day until the clinical symptoms had ceased and the urine no longer contained a pathological amount of acetone or diacetic acid. Of the 400 cases observed, symptoms of acid intoxication were present in forty-six. In some of these grave symptoms were present; in others, excepting a slight odor to the breath, there was nothing clinically to suggest this condition, and in several acetone and diacetic acid was only discovered in the urine by routine examination on entrance.

History.—The importance of this acid intoxication, produced in the organism by some metabolic change, has been recognized by a study of the intoxication occurring in diabetes mellitus. The coma found in this condition was thought to be due to the presence of acetone in the blood, and that the latter was never found excepting in diabetes. Of late years, however, it has been shown that acetonuria occurs in conditions

independent of diabetes, and that the presence of acetone and diacetic acid is probably a manifestation of the intoxication due to various fatty acids following some pathological change in metabolism.

Acetone was first recognized as a pathological constituent of the urine in connection with diabetes, by Petters, in 1857. In the same year Kaulish reported a series of cases of diabetes in which he found acetone present in the urine of a number of cases, and considered the occurrence of coma to be due to acetonæmia. This theory was disputed by Kussmaul in 1874, who doubted the toxic action of acetone to be the cause of diabetic coma. At a later period Gerhardt and others demonstrated conclusively that acetone was associated with diacetic acid and β-oxybutyric acid in the urine and blood of diabetic patients.

It has long been recognized that diabetic patients are poor subjects for anæsthesia, especially when their urine contains acetone. Becker, in 1894, reported three fatalities following anæsthesia in diabetic patients, in which acetonuria was present at the time of the operation. He considered that death was due in these cases to some cause common with the production of acetonuria, and later he examined the literature and found twelve cases in which death resulted in diabetic patients, following anæsthesia. He was led to believe, therefore, that diabetic patients, although showing no clinical symptoms of a grave condition previous to operation, were liable, owing to some change in the process of metabolism, to pass into a condition of coma and death. Brewer, in 1902, reported a fatal case of appendicitis in which he ascribed the cause of death as due to acetonæmia. Guthrie, in 1903, reported a series of cases in which death occurred following the administration of chloroform in children, in which autopsy showed the condition of fatty liver to be present. While he did not suspect the presence of acetone and diacetic acid in the urine, his description of the cases showed a set of clinical symptoms similar to those about to be described in the present article. Brackett, Stone, and Law, in July, 1904, in a report from the Boston Children's

Hospital, under the title of "Aciduria associated with Death after Anæsthesia," presented a series of fourteen cases in which death was undoubtedly due in the five fatal cases to an acid intoxication. From this list of clinical evidence of the presence of a, so far undetermined, cause in some cases of death, it can readily be seen that at times there exists a condition, not always recognized, that will have great weight in estimating the degree of a favorable prognosis in surgical cases. This condition of acid intoxication was formerly thought to occur only in fatal cases of diabetes; but late researches, including those cited above, prove conclusively that the condition is entirely independent of diabetes, and moreover that acid intoxication should be considered as a distinct lesion.

As all the cases in the literature of the subject have been presented under the term of acetonuria, and as this condition is present only as a symptom of acid intoxication, it will be used for the time being as synonymous with the latter condition.

An excess of acetone and diacetic acid in the urine has been recognized in the following diseases: (1) in the late stages of diabetes mellitus; (2) in starvation; (3) in malignant growths; (4) in digestive disturbances; (5) in septic processes, general or local; (6) in infectious fevers; (7) in pregnancy, associated with a dead fœtus; (8) in certain psychoses; (9) in autointoxications; (10) in chronic morphinism; (11) in phosphorous poisoning; (12) following general anæsthesia; (13) in injuries to the cerebrospinal system; (14) in shock due to injury; (15) in cases associated with fatty liver, and (16) probably in cases of uræmia. It has been produced experimentally by the administration of phlorizin, and by extirpation of the pancreas and solar plexus.

The presence of acetone (0.02 gramme in fifty ounces) as a normal constituent of the urine has been proven by physiologists. It is also excreted by the lungs and a very small amount is contained in the fæces. (Schwarz, L. Müller.) The amount of acetone in the urine may be increased by the administration of oleic acid, as shown by Joslin. He administered

to a patient 100 grammes of oleic acid, and found that in the twenty-four hours there were excreted 1700 milligrammes of acetone.

That the amount of acetone excreted is no indication of the severity of the acid intoxication present is shown by Brackett, Stone, and Law in the series of cases reported from the Boston Children's Hospital. In one of their fatal cases the total excretion of acetone in the twenty-four hours was approximately 142 milligrammes; and, while it is considerably more than normal, cases of diabetes have been reported in which the daily excretion of acetone was 100,000 milligrammes.

Acetone was considered by Kussmaul to be the toxic agent; but from the foregoing statement of Brackett, Stone, and Law, and from the fact that acetone has been found in the blood in large amounts, and has also been experimentally used in animals in considerable quantities without any toxic symptoms occurring, we are obliged to look for some other cause of this acid intoxication.

Naunyn considers the condition of acetonæmia as not due to the presence of acetone in the blood, but that it is an acid intoxication resulting from various fatty acids in combination with diacetic and β-oxybutyric acids.

Brackett, Stone, and Law found in all their fatal cases the presence of fatty liver, and considered that this condition may have some influence in the production of the intoxication. Their autopsy findings were similar to those of Guthrie, and in one case of the series here reported the autopsy showed the presence of fatty liver. They, however, considered that fatty liver was not a sufficient cause for death, but that it, in connection with the acetonuria, was but the result of an acid intoxication, which also caused an excessive process of oxidation in the blood with resulting lack of oxygen, and that the three conditions combined may have had something to do with the fatal results. This apparent lack of oxygen is borne out by the statement of Brewer, in describing the "air hunger" found in this condition, which "was evidenced by increased rapidity and

depth of respirations, with a bright red color of the mucous membranes and the skin, due to the presence of aërated blood in the veins from inability to absorb carbon dioxide from the tissues."

In a study of these cases, it is apparent that, following some profound change suddenly taking place, the cause of which is not yet determined, there occurs a rapid change in the body metabolism, which is shown by the presence in the urine and blood of acetone, diacetic and β-oxybutyric acids in varying quantities, associated with clinical signs and autopsy findings which have been similar to a more or less degree in all cases. What the cause is operating to produce this change in the body metabolism has not yet been determined; whether it is due to an increased destruction of proteid matter, as Heurter claims, it nevertheless remains that the condition termed aciduria, acetonuria, acetonæmia, is doubtless one of a severe acid intoxication. Edsall claimed that no specific toxic agent is at work, but that the condition is due to an excessive amount of acids due to the reduction of the alkalinity of the tissues and body fluids, and that this was produced by the acids carrying off the alkalies in combination with them, and proposed as a rational treatment the administration of large quantities of alkalies to neutralize the excess of acids present. In the severe cases of the present series large quantities of bicarbonate of soda were given by mouth, intravenously and by rectum, without any amelioration of the clinical symptoms or any production of alkalinity of the urine.

None of the theories offered so far have been thoroughly satisfactory in explaining the cause of this condition of acid intoxication. While I do not attempt to explain the cause of the symptoms present, I would like to call attention to theories, that have been advanced of late, as to the causation of uræmia and eclampsia; and it may be, as our knowledge advances, there may be a similar etiological factor in the class of cases reported and uræmia and eclampsia. Landois, in speaking of the cause of these later conditions, considers that they may be produced by the action of a toxin or toxins on what he calls

the psychomotor centres of the brain, and that at times there is a mechanical pressure on the same cortical centres. He has shown that toxins and other substances may produce all the symptoms of uræmia by local cortical action. Weisenberg found in two cases of uræmia, hemiplegia, extensive chromatolysis of the Betz cells of the paracentral lobe, and that cells in the anterior horns of the cord, medulla, cerebellum, and fibres of one motor tract showed pathological changes. Willson considers that the toxin theory cited above may play some part in the etiology of uræmia and eclampsia, and that there is another important influence at work in the form of intracranial and probably localized pressure on the psychomotor centres, and in support of this theory reports three cases. Tyson, in the discussion of Willson's paper at the meeting of the American Medical Association, June 9, 1904, thought that some toxic agent might be considered as responsible for the condition. Lambert, at the same meeting, considered that the lesions found in eclampsia to be identical with those of acute yellow atrophy of the liver. He also said that he has always noticed the apparent identity of the condition found in acute yellow atrophy of the liver and uræmia, that there was in uræmia signs of intracranial tension, and that apparently the same toxæmia was present in both conditions.

It may be that the condition of acid intoxication, whatever its cause, may be due to one similar to that found in uræmia and acute yellow atrophy of the liver. While the autopsy reports of the fatal cases at the Boston Children's Hospital do not show any evidence of intracranial pressure, yet the clinical symptoms in some of the cases were certainly those of cerebral pressure, and all were associated with fatty liver. In Guthrie's series the autopsy reports of the fatal cases showed the condition of fatty liver and clinical signs of cerebral pressure. Several cases of this series observed at the Boston City Hospital were undoubtedly due to some cerebral lesion, and were treated as cerebral concussion. Whether the theory of intracranial pressure has any bearing in the production of the symptoms of acid intoxication will only be determined by a study of future cases and experimental research.

Tests used for Acetone and Diacetic Acid.—The test used for determining the pressure of acetone in the urine is as follows: To five cubic centimetres of urine are added a crystal of sodium nitroprussiate and sufficient sodium hydrate to render the solution strongly alkaline. This is thoroughly shaken up in a test-tube. On the addition of glacial acetic acid, the presence of acetone is shown by the occurrence of a purple color to the foam.

The presence of diacetic acid is shown by a Burgundy red color appearing on the addition of a strongly aqueous solution of ferric chloride to the urine.

No quantitative examination of the urine was made in any of the cases of the series, but the amount was roughly determined by the depth of color occurring in making the qualitative tests.

Statistics.—Of the 400 cases observed at the Boston City Hospital, symptoms of acid intoxication were present in forty-six. Of the forty-six cases, acetone and diacetic acid, separately or combined, were found in the following conditions: 11 cases of appendicitis; 14 of contusions and fractures; 2 of gastric disease; 2 of carcinoma; 3 of severe lacerated contused wounds; 2 of localized septic processes; 2 of cerebral concussion; 1 of salpingitis; 1 of acute multiple suppurative osteomyelitis; 1 of floating kidney; 1 of fæcal fistula and enterocolitis; 1 of epilepsy; 1 of tuberculous cervical noditis; 1 of burns and typhoid fever; 1 of diabetic gangrene; 1 of hæmorrhoids, and 1 of alcoholism.

In seventeen cases symptoms were present on entrance; in twelve cases, within twenty-four to forty-eight hours after the administration of a general anæsthetic, ether being used in ten cases and nitrous oxide in two cases; in seventeen cases symptoms were not present at time of entrance, but developed later without any anæsthetic being administered, and for which no cause could be assigned. Acetone and diacetic acid were present in the urine at the same time in twenty-four instances; acetone alone was present in twenty cases; diacetic acid alone occurred in two cases; acetone, diacetic acid, and sugar were

present together in three cases; and acetone and sugar were together present in one case. In these forty-six cases there were six deaths.

Symptoms.—In those cases in which the condition developed a number of days after entrance and the onset could be carefully noted, the first symptom to attract attention was a peculiar apathy. This was accompanied by a marked sweetish odor to the breath, a distaste for food, slight increase in the body temperature, and in most cases vomiting.

The odor to the breath was of a peculiar, pungent, fleeting odor, or that of acetone, which at times suggested chloroform. In some cases it was very faint and could only be detected very close to the patient's mouth, in others it would be so strong as to be noticeable quite a distance from the patient's bedside. The odor became so characteristic of the condition, that after a time, when apparently there was no other symptom present, and nothing else to indicate the condition of acetonuria, on going to the bedside and catching the faint peculiar odor, it could be definitely stated that an examination of the urine would show the presence of acetone and diacetic acid.

The vomiting would occur without apparent cause, would follow immediately on taking anything into the stomach; in the mild cases it was colorless, copious, and watery in character, having a foul acid odor, contained particles of semidigested food, and in the severe cases was dark, bile-stained, of a "coffee-ground" appearance, and continued so until death. The pulse was increased in rapidity, of decreased tension, and in some cases became very weak. An absence of fever was noticeable excepting in severe cases, when the temperature would reach 102° to 103°. Alternating with the apathy there would be periods of restlessness, during which the patient required constant attention lest he fall out of bed or tear off his dressings. The face would be alternately pale or flushed, and at times expressive of considerable anxiety. In the fatal cases consciousness usually remained until near the end. From periods of restlessness, the patient would sink into a condition of stupor, or become delirious; the vomiting would

cease, cyanosis generally occurring just before death, and the respiration and the pulse gradually failed, the latter often becoming imperceptible just before breathing ceased. Several cases complained of photophobia and dimness of vision, notably Case XL.

The urine in the fatal cases was always diminished in amount, at times turbid, of high specific gravity, and in several cases contained a trace of albumen.

In the mild cases the patients complained of being drowsy and weak. There was a marked odor of acetone to the breath in all cases. The vomiting varied in amount and was not present in all cases. The tongue was dry, clean, and red. The urine always contained acetone and diacetic acid separately or together. These symptoms would last from two to three days, and usually without any special treatment, excepting the exclusion of mouth feeding, would disappear.

A number of cases in which symptoms were present on entrance were those that had sustained an injury. These cases were usually dull, apathetic, had the peculiar odor to the breath, occasionally slight vomiting, and the presence in the urine of acetone and diacetic acid. This condition would last twenty-four to forty-eight hours, and suddenly all symptoms would disappear, and the examination of the urine would show the absence of acetone and diacetic acid. Just what bearing the injury had upon the etiology of the condition it is impossible to say, excepting that there may have been some cerebral congestion present to account for the symptoms.

The case operated on for floating kidney was noteworthy for the fact that the condition did not appear until after operation, and it may be that the resulting active congestion of the kidney had some influence in the formation of toxins, which should have been eliminated by that organ, and which caused the resulting train of symptoms.

A number of cases developed symptoms after they had been in the wards many days. In these the condition could not be ascribed to injury, anæsthesia, or diet. Their mode of life in the wards was similar to that of other patients, and some of

the cases had entirely convalesced and were awaiting their discharge. While most of these cases occurred in children, no cause can be assigned for its development.

Treatment.—In the mild cases, in many instances, there was no special form of treatment adopted. If vomiting occurred, mouth feeding was prohibited; and if the condition lasted several days, nutrient enemata were given every four to six hours. Other mild cases were given bicarbonate of soda in large doses, but apparently without any marked relief in the symptoms, as compared with those not treated in this way. In the severe cases bicarbonate of soda was given by mouth; if retained, by enemata, subcutaneously and intravenously, and while for a short time there was some hope of this form of treatment doing good, it was usually of but temporary relief. In fact, in the severe cases the urine nearly always remained acid in spite of treatment. In addition the severe cases were treated symptomatically. The best results were obtained by the use of adrenalin chloride, as shown in Case I. This was given subcutaneously every eight to twelve hours; in children about 200 cubic centimetres of a 1-50,000 adrenalin saline solution, in adults 500 cubic centimetres, were used. The effect of this was shown by a marked increase in tension and slowing of the pulse; the cyanosis present would be replaced by a rather excessive ruddy appearance; the apathy would become less, and the general condition markedly improved. The effect of this stimulation would last three to four hours; and, while it was not given simply on account of the acid intoxication, it was followed by such good results as shown by the improved general condition that in all severe cases it was eventually used. To relieve the thirst, enemata of salt solution were given every six hours, alternating with nutrient enemata.

From a study of the cases, it is impossible to say that any special treatment had any direct effect upon the condition present, and the results obtained depended upon stimulation and symptomatic treatment.

The cases in detail are as follows:

CASE I.—*Acute Appendicitis.*—O. M.; aged nine years; school-boy. Admitted May 16, 1904. Service of Dr. H. W. Cushing. Family History. Negative. Previous History. Pneumonia three years ago, followed by measles and bronchitis. Severe cough the past four to five months.

Present Illness.—General malaise beginning three days ago. Vomiting began two days ago and has continued. Complained of feeling feverish yesterday. General abdominal pain began yesterday, localized in right iliac fossa this morning. Patient unable to retain anything by mouth during the past two days. Mother has noticed peculiar odor to breath the past two days.

Physical Examination.—Well developed and nourished. Face anxious and pale. Extremities cold. Pupils react equally to light. Tongue dry, red, thin yellowish coat. Mucous membrane pale. Sweetish odor to breath. No general glandular enlargement. Pulse equal, regular, of fair volume and tension, 160. Heart and lungs negative. Abdomen markedly retracted. Considerable tenderness over McBurney's point. Moderate spasm over entire right side of abdomen. General condition critical. Leucocytes, 31,400. Strychnine sulphate, $^1/_{40}$ subcutaneously, given on entrance on account of patient's condition.

Operation.—May 16, 1904, one hour after entrance. Ether. Dr. Cushing, Dr. Kelly. Vertical incision about two and one-half inches at outer border of rectus muscle, upper angle at level of umbilicus. On opening peritoneum, intestines found to be collapsed and of a grayish red color, suggesting condition found in a cadaver. Appendix retrocæcal and running upward, entirely free, slightly enlarged, and serous coat slightly injected; slight increase in circumference at middle. Appendix removed and stump touched with carbolic acid (95 per cent.) and alcohol. As condition of appendix did not seem to account for patient's serious condition, entire abdomen was explored, but nothing abnormal found. Abdominal cavity filled with normal salt solution. Sterile gauze wick to pelvis and a second one to stump of appendix. Incision closed with through-and-through interrupted silkworm gut except at point of drainage.

On opening appendix there was found, about two centimetres from tip, an area about one centimetre in diameter, of slight œdema and redness of mucosa, lumen of appendix containing a grape seed.

Patient's general condition was so grave after operation that he was given subcutaneously 250 cubic centimetres (1–50,000) adrenalin salt solution, which was followed shortly by marked improvement in pulse and general condition. Very restless after operation. Urine obtained before operation showed, color, pale; specific gravity, 1018; reaction, acid; no albumen; no sugar. Acetone present, diacetic acid absent.

May 18. Since operation sweetish odor of breath continues. Patient mildly delirious and at times very drowsy. Adrenalin salt solution, 250 cubic centimetres (1–50,000), given subcutaneously every twelve hours. Urine contains acetone and diacetic acid. Vomiting continues. Abdomen not distended. Placed on nutrients. Peptonized milk, six ounces; brandy, two ounces; salt solution, two ounces; egg, one; Tr. opii deod., gtt. iii.

May 19. Leucocytes, 11,400.

May 22. General condition markedly improved. Pulse-rate has gradually fallen to 120. Adrenalin salt solution continued every twelve hours subcutaneously. Still occasional vomiting. Acetone and diacetic acid present in urine. Odor of acetone still on breath. Delirium absent, although patient is still drowsy and resists dressing daily. Wicks started on third day and gradually shortened daily.

May 23. Leucocytes, 12,400.

May 26. Soda bicarbonate, gr. xxx, every two hours by mouth. Nutrients and adrenalin continued. Still occasional vomiting. Patient much brighter since last note. Pulse-rate steadily rising. Vomiting continues. Slight delirium yesterday. To-day expression is dull; patient sleeping most of the time; refuses everything by mouth. Odor present on breath. Acetone and diacetic acid still present in urine. Soda bicarbonate, two ounces, given intravenously yesterday and to-day. Adrenalin and nutrients continued. Dressing changed daily. Two wicks. No abdominal distention. Patient slowly failed and, in spite of active stimulants, died at 11.05 P.M.

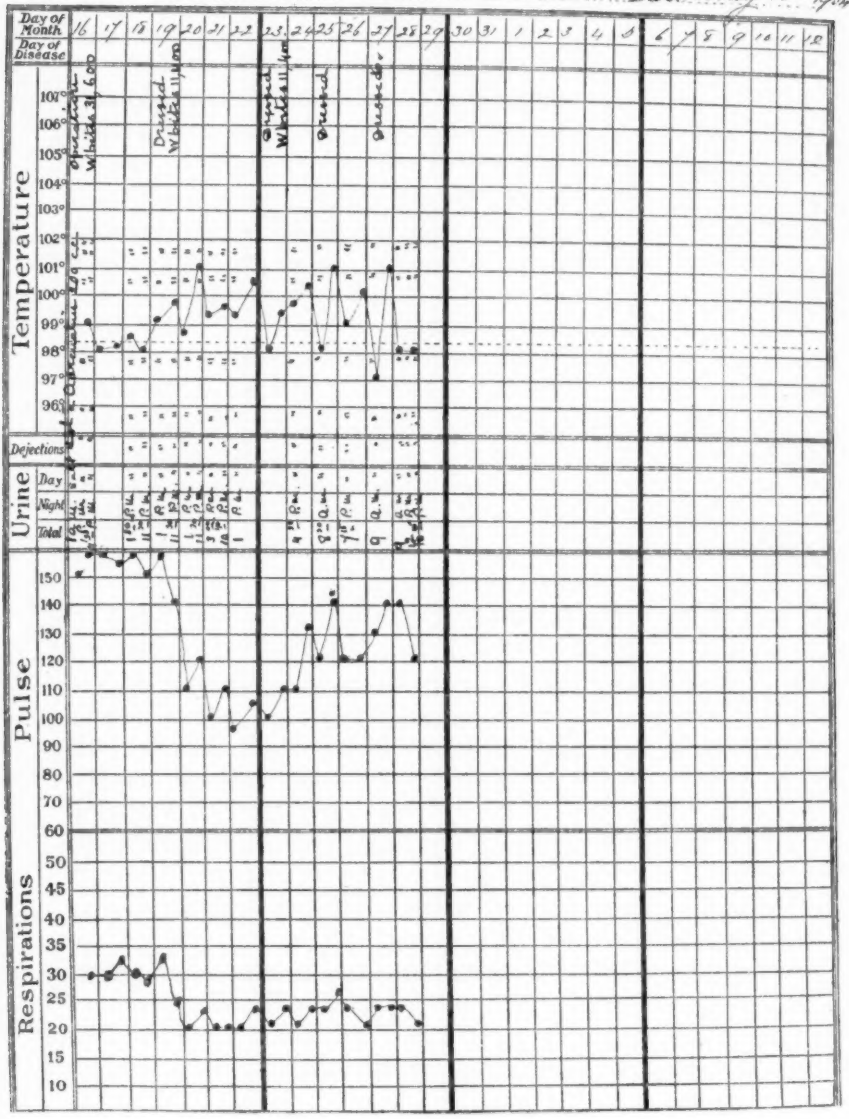
No autopsy. Examination of liver at time of operation apparently normal.

The effect of the continued use of adrenalin salt solution is shown in the appended temperature chart. It was given every twelve hours from time of entrance. The pulse-rate remained

THE BOSTON CITY HOSPITAL

CLINICAL CHART

Name..... Ward Cat. Bed No. 10 Date May 16th 1894.



at 160 for four days, then gradually decreased, and at time of death was only 120.

Throughout the entire course of the disease the patient remained conscious, although periods of apathy alternated with those of extreme restlessness, during which he would utter the most piercing shrieks, required most careful watching, and at times of changing his dressings it was impossible to do so with any degree of asepsis. The odor of acetone could be noticed throughout the room at all times. The urine the last four days was very much diminished and of high color.

CASE II.—*Contused Lacerated Wound of Foot.* (*Measles.*)—A. S.; aged four years. Admitted May 27, 1904. Service of Dr. H. W. Cushing.

Present Illness.—While mother was getting on car, the latter started, and child's foot caught under wheel.

Physical Examination.—Negative save for local condition. On dorsum of foot is a contused lacerated wound extending down to tendon sheaths, an irregular lacerated wound on plantar surface extending from toe to heel. Considerable laceration of plantar muscles. Compound dislocation of first phalangeal joint of great toe. Fracture of proximal phalanx of fifth toe.

Operation.—May 27, 1904. Ether. Dr. Kelly. Repair under aseptic conditions. Great toe amputated at terminal joint, fifth toe at metatarsophalangeal joint. Sterile dressing. Plaster-of-Paris bandage.

Examination of urine day after operation. Color, pale; specific gravity, 1025; albumen and sugar absent. Acetone and diacetic acid present. Odor of acetone to breath. No other symptoms.

May 31. Acetone present (slight). Diacetic acid absent.

June 3. Acetone and diacetic acid absent.

June 10. Patient developed measles, and was transferred to South Department. No special treatment.

CASE III.—*Fracture of Femur; Refracture.* (*Measles.*)—L. N.; aged four years. Admitted April 21, 1904. Service of Dr. H. W. Cushing. Previous History. Fracture of femur, August 11, 1903. Discharged in October, 1903. Using leg past two months without crutches.

Present Illness.—Patient fell to-day, April 21, 1904, and refractured femur. Given ether for reduction and immobilization. Urine examined April 21 and May 20, 1904, acetone and diacetic acid present.

June 15. Loss of appetite. Patient drowsy. No delirium. Odor of acetone to breath. Urine examined and found to be as follows: Pale; 1027; acid; albumen and sugar absent. Acetone and diacetic acid present. No special treatment.

June 18. Measles developed. Patient apathetic, vomited several times. Marked odor of acetone to breath. Drowsy, no delirium, urine scanty, high colored. Acetone and diacetic acid present.

June 20. Discharged to parents, as latter refused to allow child to go to South Department.

CASE IV.—*Appendicitis; Diffuse Peritonitis.*—M. F.; aged eleven years; school-girl. Admitted May 11, 1904. Service of Dr. H. W. Cushing. Family History. Negative. Previous History. Negative.

Present Illness.—First symptoms evening of May 10. Pain in epigastrium leaving this region and centring at McBurney's point. Nausea, vomiting. Temperature, 99.5° F.; pulse, 100.

Physical Examination.—Abdomen slightly distended, spasm entire right side, tenderness on pressure, greatest at McBurney's point. Leucocytes, 19,200.

Operation.—May 11, 1904. Ether. Dr. Cushing, Dr. Kelly. Fifteen hours after onset of symptoms. Vertical incision outer border of rectus muscle. Appendix up and outward behind cæcum, united to cæcum by newly formed adhesions, serosa covered with fibrin, appendix generally enlarged, no perforation. Free cloudy fluid in pelvis and extending upward on right side about appendix. Appendix removed, abdominal cavity irrigated with normal salt solution, and drained with sterile gauze wicks. Culture from fluid in pelvis showed streptococci and Bacillus coli communis. Good recovery from ether. Good convalescence. Urine negative until June 22, when acetone and diacetic acid were found. Two days previous patient gradually became drowsy, and, although she had been up and about the ward for from seven to ten days, went to bed. Marked odor of acetone to breath, vomiting, inclined to sleep. Placed on liquid diet. Patient given soda bicarbonate, gr.

xxx, every two hours until she was unable to retain anything in stomach.

June 28. General condition has improved, vomiting stopped, although patient was still apathetic and had slight odor of acetone to breath.

July 1. Still slight odor to breath, no other symptoms. Patient discharged to father on request.

CASE V.—*Fracture of Femur.*—C. E. S.; aged twenty-three years; hostler. Admitted March 26, 1904. Service of Dr. H. W. Cushing. Family History. Negative. Previous History. Negative.

Present Illness.—Yesterday, while at work, a bale of hay fell three stories to the sidewalk and bounced, striking patient under the chin; patient was thrown out into the street, sustaining fracture of right femur, and was rendered unconscious. Ether given March 27, and Buck's extension apparatus applied.

March 28. Urine, color normal; 1025; acid; no albumen; no sugar.

April 7. Urine, color normal; 1030; no albumen; sugar, one per cent. No acetone. No diacetic acid present. Patient drowsy. Loss of appetite, thirst, nausea; no vomiting. No odor to breath.

April 9. Urine again examined on account of clinical symptoms. Color, normal; 1030. Slight possible trace of albumen; sugar, one per cent. Acetone and diacetic acid present; present until April 14, when acetone and diacetic acid were absent from urine, and symptoms disappeared. Soda bicarbonate given.

May 14. Discharged relieved.

CASE VI.—*Fracture of Femur.*—W. E. D.; aged eight years; school-boy. Admitted March 17, 1904. Service of Dr. H. W. Cushing. Family History. Negative. Previous History. Negative.

Present Illness.—Patient fell off fence eight feet to ground, fracturing right femur. Ether given March 17 and Buck's extension applied.

May 17. Up and about ward.

May 20. Patient began vomiting, became drowsy, odor to breath, thirst.

May 22. Urine, pale, cloudy; 1021; acid. Albumen very slight trace. Sugar absent. Acetone present. Diacetic acid

absent; urine remained about the same until May 30, when acetone disappeared. Soda bicarbonate given until urine became alkaline.

May 30. Discharged to parents relieved.

CASE VII.—*Colles's Fracture.*—M. I. F.; aged fifty-seven years; single; housework. Admitted June 2, 1904. Service of Dr. G. H. Monks. Family History. Negative. Previous History. Negative.

Present Illness.—Patient tripped and fell on hand, receiving a Colles's fracture. Given nitrous oxide for reduction of fracture. Urine, June 2, after anæsthetic, color normal; 1022; acid; no albumen; no sugar. Acetone absent, diacetic acid present. No clinical signs.

June 3, 1904. Discharged relieved.

CASE VIII.—*Abscess of Leg.*—M. S.; aged thirty-one years; single; pickle-packer. Admitted June 2, 1904. Service of Dr. F. S. Watson. Family History. Negative. Previous History. Negative.

Present Illness.—Leg ulcer for past five years, which has at times been healed. Abscess of leg, inner side, above internal malleolus.

June 2. Urine, high color; 1020; acid; no albumen; no sugar. Acetone absent, diacetic acid present.

Operation.—June 4, 1904. Ether. Dr. Hollister. Abscess incised. No clinical symptoms after operation, excepting slight odor to breath, which continued for two days. No special treatment.

June 5. Urine, color normal; 1019; acid; no albumen; no sugar. Acetone and diacetic absent.

July 29. Discharged relieved.

CASE IX.—*Gastric Ulcer.* (*Gastro-enterostomy, Posterior.*)—A. D.; aged thirty-one years; married; female; housework. Admitted June 11, 1904. Service of Dr. J. B. Blake. Family History. Negative.

Previous History.—Abdominal distress after meals, eructation of gas, and constipation for several years. Catamenia irregular (four to six weeks), very painful, and accompanied by vomiting. One year ago similar attack to present illness.

Present Illness.—For past five weeks patient has vomited

almost immediately on ingestion of food. Considerable abdominal pain not localized. Vomitus consisted of non-digested food.

Physical Examination.—Slight epigastric tenderness. Pulsation of aorta easily felt. No evidence of aneurism.

Treatment.—Nothing by mouth but cracked ice. Nutrients every six hours. Suds enema daily.

June 12. Urine negative.

June 15. Nauseated at times since entrance. Yesterday, four minims 4 per cent. solution cocaine, and five grains cerium oxalate every four hours for control of nausea. No vomiting to-day; slight nausea during night.

June 19. Vomited at times, vomitus being streaked with blood; cocaine and cerium oxalate omitted on account of irritation. Bismuth tried and omitted.

June 23. Light diet without discomfort. No nausea.

June 27. Operation. Ether. Dr. Blake. Gastro-enterostomy, posterior.

June 28. Pulse, 120, poor quality. Patient vomited two ounces of bright blood. Patient given beef-juice in two-ounce doses. As this caused nausea, it was omitted. Again vomited blood. Morphine and adrenalin solution subcutaneously.

June 29. Abdomen distended. Pulse, 140; temperature, 100° F. Wound dressed, clean. Distention less at 6 P.M. Adrenalin solution again given, followed by improvement in pulse, then 120. Urine to-day showed presence of acetone. Diacetic acid absent. Pale, 1013. Trace of albumen.

June 30. Patient died, vomiting continuing until death. No trace of acetone in urine obtained post-mortem.

No autopsy performed.

CASE X.—*General Contusions.*—E. T. P.; aged sixty-five years; widower; no occupation. Admitted June 25, 1904. Service of Dr. F. S. Watson. Family History. Negative. Previous History. Treated five years ago for diabetes. Convulsions at irregular intervals since.

Present Illness.—Patient fell yesterday on stairway (Sullivan Square subway), striking head on railing. Unconscious until ambulance arrived, about twenty minutes.

Physical Examination, Local.—Small lacerated wound of face and forehead, aseptic dressing. No anæsthetic given. Urine, pale; 1031; acid; no albumen; sugar, 2 per cent. Acetone and

diacetic acid present. Slight odor to breath; no other symptoms. Examination of urine remained unchanged the day of discharge. No special treatment.

June 29. Discharged relieved.

CASE XI.—*Floating Kidney.*—E. F.; aged twenty-nine years; married; housework. Admitted June 9, 1904. Service of Dr. J. B. Blake. Family History. Negative. Previous History. Symptoms of floating kidney for past fourteen years.

Physical Examination, Local.—Easily palpable right kidney.

June 9. Urine negative.

June 10. Operation. Nephrorrhaphy. Ether. Dr. Blake.

Urine.	Color.	Specific Gravity.	Reaction.	Albumen.	Sugar.	Acetone.	Diacetic Acid.
June 11	Normal.	1019	Acid.	Slight trace.	0	Faintly.	Absent.
" 12	Normal.	1018	Acid.	Trace.	0	Very marked.	Present.
" 13	Normal.	1020	Acid.	Slight trace.	0	Markedly present.	Present.
" 14	Normal.	1019	Acid.	Slight trace.	0	Present.	Absent.
" 15	Normal.	1019	Acid.	Slight trace.	0	Faintly present.	Present.
" 16	Normal.	1019	Acid.	Sl. pos. trace.	0	Absent.	Absent.
" 19	Normal.	1019	Acid.	Sl. pos. trace.	0	Very faintly pres.	Absent.

To determine the effect of trauma to the kidney in this operation in reference to the production of acetone and diacetic acid in the urine, an examination was made daily. The report of each examination is noted above. While acetone and diacetic acid were present in variable quantities, at no time were there any clinical signs of an acid intoxication. The patient had an uninterrupted convalescence.

CASE XII.—*Appendicitis, Acute, with Abscess.*—J. G.; aged sixty-five years; male; married; night watchman. Admitted May 29, 1904. Service of Dr. J. B. Blake. Family History. Negative. Previous History. Negative.

Present Illness.—Four days ago pain in right lower quadrant of abdomen. Vomiting daily since. Diarrhœa from onset.

Physical Examination.—Spasm on right side of abdomen. Indefinite mass, size of an orange, felt in region of appendix. Leucocytes, 16,400.

May 30. Urine, normal; 1024; acid; no albumen; sugar, 1.6 per cent. Acetone present, diacetic acid absent.

June 1, 1904. On account of presence of acetone in urine, general anæsthesia was not considered advisable. Schleich's fluid

used 1–1000. Appendix, abscess found. Appendix not removed. Abscess cavity drained. No symptoms of acetonuria.

June 12. Sugar, 1.38 per cent. Acetone slight. No diacetic acid.

June 20. Sugar, 1.2 per cent. Acetone absent. Diacetic acid absent. Patient convalescing.

CASE XIII.—*Cerebral Concussion.*—H. F.; aged seven years; school-boy. Admitted June 6, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient run into by another boy two days ago, being thrown to ground, striking head. Not unconscious. Brought into hospital to-day on account of drowsiness, incoherence, and slight abdominal pain.

Physical Examination.—Slight laceration over occiput. A second one over right frontal region. Abrasion of right side of nose. Slight abdominal tenderness which is general. Odor of acetone to breath. Principal symptoms are mental, chiefly drowsiness and inability to think clearly. Mistakes are made in counting and in naming objects seen. Vomited several times while in hospital.

June 6. Urine slightly pale; 1018; acid; no albumen; no sugar. Slight amount of acetone present. No diacetic acid. Urine examined was the first passed.

June 8. No cerebral symptoms. Odor of acetone gone. Urine negative. Discharged relieved.

CASE XIV.—*Appendicitis, Acute, with Abscess.*—S. B.; aged fifty years; widow; housework. Admitted June 7, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Abscess of kidney twenty-four years ago (?), told so by physician. Stone removed from bladder fifteen years ago.

Present Illness.—Pain and tenderness over right side of abdomen and vomiting past two days.

Present Examination, Local—Some spasm and tenderness of right lumbar region extending into back and up towards region of gall-bladder. Dulness and resistance in right lumbar region near region of right kidney and extending to region of appendix. Point of greatest tenderness in lumbar region, outer border of erector spinæ muscles. Leucocytes, 18,000. Odor of acetone to breath. Patient drowsy.

June 8. Urine slightly high and cloudy; 1020; alkaline; no albumen; no sugar. Acetone and diacetic acid present.

June 15. Urine negative.

June 17, 1904. Operation. Ether. Dr. H. A. Lothrop, Dr. Kelly. Incision outer border of erector spinæ muscles. Abscess cavity containing about two ounces of pus; at bottom of abscess appendix could be felt, and was apparently retroperieoneal. Appendix not removed. Abscess cavity drained. Uninterrupted convalescence.

July 10. Discharged relieved.

CASE XV.—*Cerebral Concussion.*—J. M.; aged ten years; school-boy. Admitted June 15, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient fell off furniture wagon to ground, striking head and abdomen. No subjective symptoms of concussion excepting confusion of ideas for first twelve hours. Odor of acetone to breath on entrance.

June 17. Urine, normal; 1016; acid; no albumen; no sugar. Acetone present; diacetic acid absent.

June 19. Urine negative. No clinical symptoms.

June 20. Discharged relieved.

CASE XVI.—*Fracture of Humerus; Fracture of Clavicle.*—K. B.; aged eight years; school-girl. Admitted June 18, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient fell two stories from a fire-escape, sustaining epiphyseal separation of upper end of right humerus and green-stick fracture of right clavicle. No clinical symptoms of acetone excepting a slight suggestion of odor to breath. Urine, normal in color; 1028; acid; no albumen; no sugar. Acetone and diacetic acid present. No anæsthesia given to apply fixation dressing.

June 20. Urine, color normal; 1026; acid; no albumen; no sugar. Acetone and diacetic acid absent. No clinical symptoms. No special treatment.

June 21. Discharged relieved.

CASE XVII.—*Carcinoma of Uterus.*—E. P.; aged fifty-five years; married; housework. Admitted June 11, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Negative.

Present Illness.—Symptoms of uterine fibroid for past five or six years.

June 12. Urine, normal; 1023; acid; very slight trace of albumen; no sugar. Acetone and diacetic acid absent.

June 15. Operation. Ether. Dr. Bolles, Dr. Kelly. Hysterectomy. Pathological report shows carcinoma of the uterus near fundus, also several fibroids.

June 17. Urine, normal; 1020; acid; no albumen; no sugar. Acetone present, diacetic acid absent. Acetone odor to breath. Slight vomiting for four days after operation, then no signs of acetonuria clinically or in urine. Uninterrupted convalescence.

July 7, 1904. Discharged relieved.

CASE XVIII.—*Blank-Cartridge Wound of Hand.*—F. Q.; aged nine years; school-boy. Admitted June 17, 1904. Service of Dr. W. P. Bolles.

Present Illness.—While loading pistol with blank cartridge, the latter accidentally exploded, wounding the hand of the patient.

June 17, 1904. Operation. Ether. Dr. Kelly. Wound thoroughly curetted; antiseptic precautions. Urine passed that night showed color normal; 1022; acid. Albumen and sugar absent. Acetone and diacetic acid present. No clinical symptoms except slight odor to breath.

June 20. Urine. No acetone or diacetic acid present. Culture taken at operation showed absence of tetanus bacillus.

June 21. Discharged relieved.

CASE XIX.—*Lacerated Wounds of Hand from Cannon Cracker.*—M. O'B.; aged nine years; school-girl. Admitted June 18, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient picked up a lighted cannon cracker, the latter exploding in hand. Local examination; compound dislocation of thumb, palm of hand torn, exposing second metacarpal, first finger severely lacerated.

June 18. Operation. Ether. Dr. Kelly. Index-finger amputated at first joint, middle finger at terminal joint. Examination of urine passed night of operation was as follows: Color, normal; 1024; acid; no albumen; no sugar. Acetone and diacetic acid present. Acetone and diacetic acid persisted in urine three days. No clinical symptoms.

June 29. Discharged relieved.

CASE XX.—*Fracture of Ulna.*—B. D.; aged ten years; school-boy. Admitted June 30, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient, morning of entrance, fell from a fence, a distance of eight feet, falling on left forearm, sustaining a fracture of ulna and lacerated wound of forearm.

June 30. Operation. Ether. Dr. Kelly. Aseptic repair of wound; fracture found not to be compound. Examination of urine passed eight to ten hours after operation showed color pale; 1018; acid; no albumen; no sugar. Acetone and diacetic acid present. No clinical signs. Acetone and diacetic acid present in urine for two days.

July 6. Discharged relieved.

CASE XXI.—*Fracture of Tibia.*—K. C.; aged twenty-seven; female; single; housework. Admitted July 1, 1904. Service of Dr. Paul Thorndike.

Present Illness.—Two days before admission patient fell down steps and turned on foot, sustaining fracture of middle of right tibia.

July 2. Urine, light color; 1018; acid; no albumen; no sugar. Acetone and diacetic acid present. No anæsthetic given. No clinical signs. Acetone and diacetic acid present in urine for three days.

July 29. Discharged relieved.

CASE XXII.—*Acute Multiple Suppurative Osteomyelitis.*—G. S.; aged twelve years; school-girl. Admitted April 4, 1904. Service of Dr. H. W. Cushing. Family History. Negative. Previous History. Negative.

Present Illness.—Patient unable to walk for past week on account of pain in right knee. Four days ago right thigh (lower third) and knee increased in size, accompanied by night cries, increased local temperature, pain, redness, and tenderness.

Physical Examination.—Well developed and nourished. Apprehensive. Face flushed. Tongue, white coat and dry. Pulse, 130; temperature, 102° F.

Local.—Right lower half of right thigh swollen, red, deep fluctuation, slight synovitis of knee.

Operation.—April 6, 1904. Ether. Dr. Hubbard, Dr. Kelly. Two lateral incisions over lower thigh, large quantity of pus evacuated. Periosteum stripped from bone. Culture showed pure culture of Staphylococcus pyogenes aureus. Urine, negative.

April 10. Second operation. Ether. Dr. Hubbard, Dr. Kelly. Left upper humerus, incision made and pus outside shaft, four trephine holes made, and pus found in medullary cavity

(culture, Staphylococcus pyogenes aureus). Right lower femur trephined, pus found in medullary cavity (culture, Staphylococcus pyogenes aureus). Left lower femur trephined, no pus found (culture, Staphylococcus pyogenes aureus).

April 13. Third operation. Ether. Dr. Hubbard, Dr. Kelly. Lower end of right fibula trephined, pus outside bone and in medullary cavity (culture, Streptococcus pyogenes aureus, Staphylococcus pyogenes aureus, Bacillus subtilis). Blood culture, April 24, 1904, Streptococcus pyogenes aureus.

April 25. Parotid abscess incised. Ethyl chloride. Dr. H. W. Cushing, Dr. Kelly.

Repeated examinations of urine were made, and until May 9 acetone and diacetic acid were absent. On May 8 there was noticed a peculiar odor to the breath, accompanied by drowsiness, vomiting, and increased pulse-rate. Examination of the urine revealed the presence of acetone, and on the following day diacetic acid. The patient was given soda bicarbonate, gr. xxx, every two hours until she failed to retain anything by mouth, when she was given enemata containing soda bicarbonate, two ounces every four hours, until death, which occurred May 20. During the four days preceding death the patient was given subcutaneously 200 cubic centimetres of adrenalin salt solution (1–50,000) with slight favorable results. Nutrient enemata and stimulation were freely given. During the last four days patient had periods of restlessness alternating with stupor. The tongue remained a reddish color, and at all times was extremely dry. On account of screaming and apparent pain, sedatives were required, and towards the end vomiting ceased; the patient passed into a state of coma, the urine became very scanty, and death occurred very suddenly. Autopsy permission was not granted by parents. Patient died May 20.

Daily examinations of urine were as follows:

Urine.	Color.	Specific Gravity.	Reaction.	Albumen.	Sugar	Acetone.	Diacetic Acid.	Indican.
May 8	Slig'tly high	1020	Acid.	o	o	Absent.	Absent.	Absent.
" 9	Pale.	1018	Acid.	o	o	Present.	Absent.	Present.
" 12	Pale.	1014	Acid.	o	o	Present.	Present.	Present.
" 13	Cloudy.	1015	Acid.	o	o	Increasing.	Present.	Present.
" 14	Pale.	1015	Acid.	o	o	Present.	Present.	Present.
" 15	Pale, cloudy.	1015	Alkaline.	o	o	Not so marked	Present.	Absent.
" 16	Pale.	1017	Acid.	o	o	Present.	Present.	Absent.
" 17	Pale.	1015	Acid.	o	o	Present.	Present.	Absent.
" 19	Cloudy.	1017	Acid.	o	o	Present.	Present.	Absent.

CASE XXIII.—*Appendicitis.*—M. S.; aged thirty years; male; married; bricklayer. Admitted June 3, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Negative.

Present Illness.—Well until three days ago. Pain in left lower quadrant of abdomen, then in right. Bowels constipated. Slight nausea this morning.

Local.—Some tenderness on deep pressure in right iliac fossa. Leucocytes, 10,200. Urine, June 6, normal; 1026; acid; no albumen; no sugar. Acetone and diacetic acid present. Patient refused operation. No clinical symptoms present except odor to breath.

June 6. No symptoms of appendicitis since yesterday. Examination of urine negative. As patient desires to go home, he is discharged.

CASE XXIV.—*Compound Fracture of Tibia.*—P. H.; aged forty-six years; male; peddler. Admitted June 8, 1904. Service of Dr. F. S. Watson.

Present Illness.—Wheel of ice wagon went over left leg, causing compound fracture of tibia.

June 8, 1904. Operation. Ether. Dr. Hollister. Aseptic repair. Sterile dressing plaster-of-Paris bandage. Urine passed that night showed normal; 1024; acid; no albumen; no sugar. Acetone present, diacetic acid absent. No clinical symptoms present excepting odor to breath.

July 8. No symptoms since operation. Acetone present in urine two days.

CASE XXV.—*Fracture of Fibula.*—J. G.; aged thirty-three years; male; hair-dresser. Admitted June 9, 1904. Service of Dr. F. S. Watson.

Present Illness.—Patient turned ankle stepping from street to curb. Urine, June 11, normal; 1022; acid; no albumen; no sugar. Acetone present, diacetic acid absent. No clinical signs. Presence of acetone discovered in routine examination.

June 12. Acetone and diacetic acid absent.

June 20. Discharged relieved.

CASE XXVI.—*Appendicitis, Acute, with Abscess.*—J. D.; aged twenty-five years; warehouseman. Admitted June 11, 1904. Service of Dr. F. S. Watson.

Present Illness.—Two days ago pain in abdomen. Vomited

several times during first two days; none since. Bowels open. Pain decreasing until to-day, when it grew worse.

Local Examination.—Abdomen moderately distended. Tenderness and muscular spasm on right, a distinct tender mass in right lower quadrant, region of appendix. Leucocytes, 21,400.

Operation.—June 11, 1904. Ether. Dr. E. H. Nichols. Abdomen opened. Appendix found to be long, ruptured, and gangrenous, surrounded by an abscess cavity. Urine passed June 11 showed high; 1035; acid; no albumen; no sugar. Acetone present, diacetic acid absent. No clinical symptoms. No further examination of urine made. Uneventful convalescence.

CASE XXVII.—*Diabetes; Gangrene of Foot.*—G. W.; aged sixty-six years; expressman. Admitted June 10, 1904. Service of Dr. F. S. Watson.

Local Examination.—Left hand shows small ulceration of third and fourth fingers. Right toe shows ulceration size of dime on inner side of metatarsophalangeal joint. Ulcer clean and surrounded by a reddened area. Left foot, the fourth and fifth toes, all cold and black, in a condition of dry gangrene. Urine, June 15, before operation, normal; 1023; acid; no albumen; sugar present, 1.70 per cent. No acetone, no diacetic acid.

Operation.—June 15, 1904. Ether. Dr. F. S. Watson. Amputation of left leg just above knee-joint. Urine passed June 20, normal; 1036; acid; no albumen; no bile; sugar, 1.80 per cent. Acetone and diacetic acid present. No clinical symptoms.

June 26. Examination of urine negative, excepting sugar present 1 per cent.

July 10, 1904. Discharged relieved.

CASE XXVIII.—*Appendicitis, Acute Catarrhal.*—N. M.; aged twenty-one years; male; painter. Admitted June 20, 1904. Service of Dr. F. S. Watson. Previous History. First attack six months ago.

Present Illness.—Sudden pain in abdomen three days ago. Bowels constipated until yesterday, when moved by an enema. No vomiting. Pain is now confined to right lower quadrant of abdomen.

Local.—Tenderness on deep pressure in right lower quadrant of abdomen. No muscular spasm. Nothing felt.

June 21. Urine normal; 1022; acid; no albumen; no

sugar. Acetone present, no diacetic acid. Slight odor of acetone to breath. Leucocytes, 8800.

Operation.—June 22, 1904. Ether. Dr. F. S. Watson. Appendix found to be in a condition of mild inflammation. Appendix removed.

June 25. Urine negative. Normal convalescence.

CASE XXIX.—*Fracture of Femur.*—A. R.; aged fifty-two years; female; housework. Admitted June 20, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Fell from an electric car, fracturing left femur.

June 21. Urine, normal; 1010; acid; albumen, very slight trace. No casts. Normal and abnormal blood. No sugar. Acetone and diacetic acid present, found in routine examination.

June 23. Urine negative, except slight trace of albumen. No clinical symptoms. No anæsthetic given for application of extension apparatus.

CASE XXX.—*Alveolar Abscess.*—F. G.; aged twenty-two years; travelling salesman. Admitted May 3, 1904. Service of Dr. A. Post.

Present Illness.—Tooth began to ache seven days ago. Extracted two days ago. Face began to swell six days ago.

Local Examination.—Entire right side of face shows swelling and brawny induration with but little tenderness. Patient unable to open mouth.

June 1. Urine, high colored; 1030; acid; no albumen; no sugar. No acetone, no diacetic acid.

Operation.—June 1, 1904. Nitrous oxide. Dr. Hollister. Incision.

June 2. Urine, high; 1030; acid; no albumen; no sugar. Acetone present, no diacetic acid found in routine examination.

June 3. Urine negative. No clinical symptoms.

CASE XXXI.—*Appendicitis, Acute, with Abscess.*—H. P.; aged twenty-five years; female; book-keeper. Admitted June 17, 1904. Service of Dr. F. S. Watson.

Present Illness.—Three days ago at night sudden onset of cramp-like pains in lower abdomen. Diarrhœa and vomiting. Vomiting continued for three days, vomitus yellow liquid. Diarrhœa lasted twenty-four hours. One movement yesterday, following administration of castor oil. Vomited everything but soda

water taken last night. Pain in centre of abdomen continued same as at onset.

Local.—Slight increased spasm on right. Tenderness across entire lower half of abdomen. Leucocytes, 19,000.

June 19. Urine (turbid), 1030; acid; slight trace of albumen; no sugar. Acetone present, no diacetic acid found in routine examination.

June 20. Same as day before, plus presence of diacetic acid. No clinical signs except odor to breath.

June 21. Tenderness was marked in right lower quadrant.

Operation.—June 29, 1904. Ether. Dr. E. H. Nichols. McBurney incision. Gangrenous appendix with abscess. Appendix removed; drainage.

June 29. Urine negative. Normal convalescence. Acetone present in urine seven days.

CASE XXXII.—*Epilepsy.*—T. S.; aged thirteen years; male; no occupation. Admitted June 13, 1904. Service of Dr. F. S. Watson. Family History. Negative.

Previous History.—At thirteen months began to have convulsions; had them until three years old; then none until nine years old. Pneumonia nine years ago. Malaria five years ago.

Present Illness.—Since malaria five years ago has had convulsions. Attacks come on while standing up, when he will fall; bites tongue. During the past three weeks has talked incoherently, and laughs to himself; has been getting very weak and losing weight; has several convulsions a day. Attacks last from two to three minutes. Appetite capricious.

Physical Examination.—Well developed and poorly nourished. Stellate scar in left eyebrow. On right postparietal region a tumor three centimetres in diameter closely adherent to skull, over which the skin moves; indefinite sense of fluctuation in tumor. Epileptic attacks since entrance.

June 14. Urine, color normal; 1020; acid; no albumen; no sugar; no acetone; no acetic acid.

Operation.—June 15, 1904. Ether. Dr. E. H. Nichols. Tumor dissected out. Pathological report, chronic inflammatory.

June 18. Urine, normal; 1022; acid; no albumen; no sugar; acetone present; no diacetic acid.

June 20. Acetone absent.

June 27. No convulsive attacks since operation. Urine negative. Discharged relieved.

CASE XXXIII.—*Tuberculous Cervical Noditis.*—H. D.; aged sixteen years; female; housework. Admitted June 3, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Negative.

Present Illness.—Patient has noticed swellings of both sides of neck since age of nine years, swelling increasing in size every winter.

Local Examination.—Swelling size of small egg just below left ear and another just below this at base of neck. Below right ear there is a fluctuating swelling the size of a walnut.

June 4. Urine, slightly high and cloudy; 1019; acid; no albumen; no sugar; acetone present. No diacetic acid found in routine examination. No clinical symptoms.

Operation.—June 9, 1904. Ether. Dr. H. A. Lothrop, Dr. Kelly. Dissection of glands.

June 8–12. Urine negative. Pathological report, tubercular lymph-nodes.

June 21. Discharged relieved.

CASE XXXIV.—*Appendicitis, Chronic, with Adhesions; Inguinal Hernia.*—W. B.; aged twenty-six years; physician. Admitted June 10, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Inguinal hernia for past six years. During the past nine months has had eight attacks of appendicitis.

Present Illness.—Pain, colicky, past four days; tenderness over appendix region, also in lumbar region. No vomiting. No digestive disturbance.

June 10. Urine, normal; 1025; acid; no albumen; no sugar; acetone present. No diacetic acid found in routine examination. No clinical signs.

Operation.—June 18, 1904. Ether. Dr. H. A. Lothrop, Dr. Kelly. Appendectomy. Bassini operation on hernia. Pathological report of appendix, chronic obliterative appendicitis. Uneventful convalescence. Subsequent examinations of urine negative.

July 12. Discharged relieved.

CASE XXXV.—*Fracture of Radius.*—D. S.; aged seven years; school-boy. Admitted June 11, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Negative.

Present Illness.—Patient fell off roof, fifteen feet, to ground, sustaining slight abrasion of face and fracture of lower end of left radius.

June 11. Urine, normal; 1025; acid; no albumen; no sugar. Acetone present; diacetic acid present in small amount. No clinical signs except odor of breath.

June 13. Urine negative. Ether given two days after admission for reduction of fracture.

June 18. Discharged relieved.

CASE XXXVI.—*Fracture of Pelvis.*—S. P.; aged fourteen years; male; clerk. Admitted June 18, 1904, to Relief Station, Boston City Hospital. Transferred to Main Department, Boston City Hospital, June 20, 1904. Service of Dr. W. P. Bolles.

Present Illness.—Patient is said to have fallen off his team and been run over by another team.

Physical Examination.—Well developed and nourished. Pale; hysterical. In considerable shock. Pulse rapid and weak. Considerable general tenderness of abdomen. Voluntary spasm. Contusion and abrasion of right flank. Ecchymosis of left groin. Crepitus in left pelvis. Considerable swelling of left thigh. Rectal examination shows fracture of descending ramus of left pubis and of fragment in immediate neighborhood of anterior wall of rectum.

June 20. Urine passed, normal; 1023; acid; no albumen; no sugar. Acetone present; no diacetic acid. No clinical signs except odor to breath. June 23. Urine negative. July 10. Convalescing.

CASE XXXVII.—*Salpingitis.*—G. C.; aged twenty-one years; table-girl. Admitted June 25, 1904. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Colicky pains in lower abdomen at menstrual period.

Present Illness.—During past month has had occasional slight pain in right lower abdomen, which increased in severity past four days.

Local Examination.—Slight tenderness in right suprapubic region, slight vaginal discharge.

June 26. Urine passed, normal; 1020; acid; no albumen; no sugar. Acetone and diacetic acid present. No clinical signs but odor to breath.

June 29. Urine negative. Discharged relieved. No operation.

CASE XXXVIII.—*Carcinoma Descending Colon; Intestinal Obstruction.*—F. M.; aged twenty-nine years; married; housework. Admitted May 22, 1904. Service of Dr. Paul Thorndike. Family History. Negative. Previous History. Symptoms of gradually increasing obstruction two days before entrance, absolute constipation, vomiting.

May 23. Urine, normal; 1025; acid; slight possible trace of albumen; no sugar; no acetone; no diacetic acid.

Operation.—May 25, 1904. Ether. Dr. Paul Thorndike. Laparotomy. Carcinomatous mass found involving descending colon and sigmoid. Left inguinal colostomy.

June 15. Urine, slightly high; 1020; acid; no albumen; no sugar; acetone present; no diacetic acid. No clinical signs.

June 22. Urine negative. Normal convalescence.

CASE XXXIX.—*Appendicitis, Acute, with Abscess.*—J. C.; aged thirty years; married; driver. Admitted June 29, 1904. Service of Dr. F. S. Watson. Family History. Negative. Previous History. Negative.

Present Illness.—Sudden attack of cramp-like pain in abdomen yesterday morning. Vomited last night. Pain now localized in appendix region. Bowels constipated for past two days.

Physical Examination.—Looks sick. Odor of acetone to breath. Abdomen, scaphoid; marked muscular spasm on right side; great tenderness over region of appendix. Leucocytes, 25,000.

July 1. Urine, normal; 1030; acid; no albumen; no sugar. Acetone present; no diacetic acid.

Operation.—July 2, 1904. Ether. Dr. W. E. Faulkner. Appendix found to be gangrenous and was removed. Localized peritonitis. Drainage. Good recovery and convalescence. Pathological report, culture taken was sterile. Acute gangrenous appendix.

July 5. Urine negative; no further clinical signs; normal convalescence.

CASE XL.—*Fæcal Fistula.*—A. S.; aged forty years; female; baker. Admitted February 8, 1904, to Dr. H. W. Cushing's service.

Patient transferred from Medical Department, where she entered six days ago with history of steady vomiting for three weeks, associated with ingestion of food and slight epigastric pain and tenderness. Vomitus chiefly food material and containing no

blood. Seven years ago had an abscess in right groin, which still discharges at intervals. Since entrance on medical service patient has had continual vomiting. Fed by nutrient enemata.

Physical Examination.—Well developed and nourished. Pupils equal and react to light. Tongue much reddened and dry. Throat reddened. No general glandular enlargement. Pulse equal, regular, fair volume, and tension. Heart, soft systolic at apex transmitted a short distance into axilla. Lungs negative. Reflexes normal. No œdema of extremities. Sweetish odor to breath. Abdomen, slight dulness in right side over an area the size of palm of hand; palpation reveals a rather soft, slightly irregular, apparently adherent mass which is slightly tender on pressure, about one-half inch above Poupart's ligament and one inch internal to anterior superior spine of right ileum. There is a sinus surrounded by an area the size of silver dollar of scar tissue. Probe introduced runs backward, slightly upward and outward, for a distance of about three inches. Pressure on mass in right side of abdomen causes flow of pus from sinus.

February 10. After transfer from Medical Service patient vomited several times after taking small amounts of water by mouth; then fed by nutrient enemata; and at the end of twenty-four hours, as no vomiting had ocurred and patient failed to retain two enemata, nourishment in the form of beef tea and Mellin's Food was given by mouth. Sweetish odor noticed on breath has continued to be present. Patient complains of feeling very drowsy, dry, and very weak; considerable photophobia and dimness of vision. Patient states that she has been menstruating for the past sixteen days. Considerable difficulty in obtaining specimen of urine. To-day about two ounces obtained, of which a satisfactory examination could not be made. Last night patient rejected several nutrient enemata. No vomiting has occurred except as above noted. Five loose bowel movements yesterday.

February 12. General condition about the same. Drowsiness, photophobia, and dimness of vision still continue. Tongue extremely red and dry. No urine passed yesterday. Catheterized and twelve ounces of urine obtained, which was amount secreted in past twenty hours. Patient again catheterized to-day, at end of twenty-four hours, and fourteen ounces of urine obtained. Examination of urine yesterday showed presence of acetone and diacetic acid.

February 12, 1904. Urine, twenty-four hours' amount, about 500 cubic centimetres. Color high; slightly turbid; 1020; acid; urea, 2.65 per cent. Indican present. Chlorides normal. No albumen. No sugar. No bile pigments. Acetone and diacetic acid present. Daily amount passed, eight to fourteen ounces. Starch enemata given yesterday and to-day for diarrhœa. On giving enema it was noticed that there was slight bubbling of gas and slight discharge of fluid from sinus above Poupart's ligament. Patient given yesterday thirty grains soda bicarbonate every two hours. Patient has retained all liquid nourishment by mouth until this morning, when she vomited about one ounce of semi-digested greenish, foul-smelling fluid. Eyes examined to-day by Dr. Allen Greenwood, who reports, "Examination of fundi shows nothing abnormal. Vessels appear normal as to size and color. Nerve heads normal. The partial loss of sight might be due to some disturbance in the postoccipital lobes such as occurs in the blindness of pregnancy without fundus changes. Possibly some toxic influence affecting the region of the brain mentioned."

February 15. Since last note patient has been semidelirious. Incontinence of fæces present past three days. Takes small amounts of liquid nourishment and complains of constant thirst. Fæcal discharge from sinus in right inguinal region. Sweetish odor still present in breath. Patient's general condition has slowly failed and, in spite of active stimulants, she died at 8.03 this morning. No autopsy.

Case XLI.—*Gastric Dilatation* (*Gastro-enterostomy, Posterior*).—R. M.; aged nineteen years; drug-clerk. Admitted May 18, 1904. Service of Dr. Abner Post.

Present Illness.—Indigestion past three years. Vomiting after meals past two months, one to two hours after eating. Transferred from medical service, where urine was not examined for acetone or diacetic acid. More or less vomiting during the past three months.

May 19. Urine, high; 1030; no albumen; no sugar. Acetone present; no diacetic acid; has vomited no blood.

Operation.—May 31, 1904. Ether. Dr. Paul Thorndike. Stomach and intestines found normal. Anterior gastro-enterostomy done. Good ether recovery.

June 1 and 2. Urine, high; 1032; no albumen; no sugar.

Acetone present; no diacetic acid. Vomiting continued after operation. Constant epigastric pain.

June 15. Condition same, drowsy, dull.

June 21. Failing steadily, vomiting continually. Odor of acetone to breath. Slightly delirious. Gradually failed; coma lasted four days, died June 24. No autopsy. Temperature subnormal two and a half weeks before death. Pulse-rate rose from 60 at time of operation steadily to 110 at time of death.

CASE XLII.—*Acute Alcoholism.*—R. H.; aged thirty-two years; female; married; housework. Admitted March 16, 1904. Service of Dr. G. G. Sears. Family History. Negative. Previous History. Negative.

Present Illness.—Debauch two weeks ago, has been vomiting night and day since. Has eaten no solid food since, but has continued drinking. Three days ago vomited blood. Dull, constant pain in epigastrium. Low eructation. Headache for past two days. Has had flashes of light before eyes. Passes urine once in twenty-four hours.

Physical Examination.—Well developed and nourished. Skin dry. Obese. Marked odor of acetone to breath. Tongue red and dry. Throat dry. Heart and lungs normal. Liver-dulness normal. Slight epigastric tenderness. Vomiting lasted three days following entrance.

March 16. Urine, normal color; 1025; neutral; slight trace of albumen; no sugar. Acetone and diacetic acid present. Amount passed in twenty-four hours averaged during ten days from ten to twenty-two ounces.

March 20. Takes food readily now. Acetone odor has disappeared. Examination of urine negative. Good convalescence.

CASE XLIII.—*Burns; Typhoid Fever.*—B. P.; aged sixteen years; female; no occupation. Admitted December 21, 1903. Service of Dr. F. S. Watson.

Previous History.—Epileptic attacks since age of two. No attacks from ten to fifteen years of age. Since then irregularly until past three weeks, when they have occurred every other day.

Present Illness.—Two days before entrance, patient during an epileptic attack fell on an oil-stove, sustaining burns of both arms and chin.

Physical Examination.—Excessive sloughs of both forearms.

Considerable swelling, redness, and tenderness of inside of both arms. Glands in axillæ.

December 22. Urine negative.

December 29. Wounds granulating.

January 11, 1904. Wounds granulating fairly well. Heart's action rapid. Temperature elevated. Patient complains at times of abdominal pain relieved by enemata. General condition fair.

January 18. Burns doing well. For several days has complained of abdominal pain and vomiting. Has not taken food well. The possibility of intestinal ulcer is considered and patient is put on rectal feeding. Considerable tenderness in epigastrium. Very pale. Pulse weak and rapid, and patient apparently failing.

January 25. Patient is failing. After being kept on rectal feeding for one week, has been given small amounts of liquid by mouth, but vomits everything. Burnt areas healing slowly. Patient seen in consultation by Dr. H. S. Burrell, at whose suggestion urine was examined for acetone, which was present in large amount. Odor to breath. Patient very stupid, dull, and drowsy. Given solution of bicarbonate of soda subpectorally, later also added to nutrients. Patient continued to vomit and died. Widal negative. Leucocytes, 10,200.

Autopsy January 26, 1904. Body, Dr. Mallory; head, Dr. Southard. Autopsy, twenty-one hours' post-mortem. Aged sixteen years. Body length, 160 centimetres.

Fairly well developed, very poorly nourished white female. Slight lividity of dependent portions and slight rigor mortis. Œdema noted in tissue of chest on section, not noticeable in extremities due to salt infusion. Pupils equal. Rather extensive granulating superficial wounds of each forearm.

Peritoneal Cavity.—Contains 400 cubic centimetres of straw-colored fluid slightly clouded with small flakes of fibrin. Intestine grayish, smooth, and shining; show many dark-red, firm areas in lower portions of ileum, most marked at ileocæcal valve. Mesenteric lymph-nodes are large (two centimetres diameter and less), of dark-red color and firm. On section, cut surface is of uniform grayish pink with pin-head, whitish areas scattered over it.

Pleural Cavity.—Not remarkable. *Pericardial Cavity.*—Contains thirty cubic centimetres of clear straw-colored fluid. *Heart Weight*, 190 grammes. Subepicardial fat in small amount. *Myo-*

cardium dark red and firm, shows in fresh section (Scharlach R. stain), no fat. *Endocardium* and *valves* normal. Coronary arteries not remarkable.

Measurements.—Tricuspid valve, 11 centimetres; pulmonary valve, 6 centimetres; mitral valve, 8 centimetres; aortic valve, 5.5 centimetres; left ventricle, 1.5 centimetres; right ventricle, 0.5 centimetre.

Lungs.—Of delicate pink color anteriorly, dark blue at back, crepitate throughout. On section not remarkable.

Spleen Weight, 245 grammes. Capsule tense. Substance dark red and firm. Trabeculæ and Malpighian bodies visible.

Gastro-intestinal Tract.—Peyer's patches in lower 150 centimetres of ileum appear as dark red, firm, slightly elevated areas with long axis in direction of intestinal lumen. Some of these just above ileocæcal valve show small yellowish sloughs still attached to surface. Other patches show small ragged superficial ulcerations. *Pancreas* appears normal. *Liver Weight,* 1640 grammes. On section, cut surface is of brownish-red color, paler than usual, and rather friable. No focal lesions seen. Central veins empty. Fresh section (Scharlach R. stain) shows very slight amount of fat in peripheries of lobules.

Kidney Weight, 295 grammes. Capsule strips readily, leaving smooth surface. Cortex of light grayish color, fairly firm, is distinctly marked off from dark-red pyramids, and shows glomeruli as fine, glistening, pinpoint elevations. Fresh section (Scharlach R. stain) shows no fat.

Adrenals appear normal. *Bladder,* genital organs, and aorta appear normal.

Head.—Hair thick, dark. Scalp normal. Cranium thin, without diploë. Dura adherent to calvarium under bregma. Sinuses contain fluid blood. Villi slightly developed. Pia bags out loosely, containing considerable clear fluid, which can be moved about readily between gyri. A few fibrous streaks and thickenings in pia alongside veins, notably in Sylvian fossæ. Gyri not œdematous, strike one at first as narrowed, but prove normal on section. Puncta crumenta distinct in medullary portion of substance. Ventricles contain a slight surplus of clear fluid. Ependyma of floor of lateral ventricles has a rather coarse, salt-sprinkled appearance. Interbrain, isthmus, and cerebellum normal.

Middle Ears.—Normal.

Anatomical Diagnoses.—Chronic external pachymeningitis; chronic fibrous leptomeningitis; œdema of pia; moderate chronic internal hydrocephalus; chronic ependymitis; lesions of typhoid fever; acute splenitis; hyperplasia of mesenteric lymph-nodes; hyperplasia of Peyer's patches with necrosis; ascites; fatty liver.

CASE XLIV.—*Fracture of Shaft of Femur.*—H. S.; aged six years; school-boy. Admitted October 26, 1903. Service of Dr. W. P. Bolles. Family History. Negative. Previous History. Negative.

Present Illness.—Patient fell from back of team, catching leg in wheel, receiving lacerated wound just below knee and transverse fracture of middle shaft of femur.

October 23, 1903. Operation. Ether. Dr. Kelly. Repair, suture of wound. Plaster-of-Paris spica.

December 10. Ether given again on account of malposition of fragments, union broken up and apparatus (extension) applied.

February 25. Convalescence. All apparatus off. Patient up.

February 29, 1904. Three days ago patient vomited several times, and had slight puffiness of face. Urine became smoky and showed microscopical blood.

February 28. Urine, smoky; 1030; acid; albumen, one-eighth of 1 per cent.; no sugar. Acetone and diacetic acid present. Normal and abnormal blood. No casts or renal cells seen. Next day patient somewhat improved. Not so well to-day and has vomited considerably. Some headache. Acetone odor to breath. Two days ago acetone and diacetic acid present in urine. Some puffiness of face.

March 1. Acetone and diacetic acid present in urine; no blood; no albumen.

March 3. Acetone and diacetic acid absent from urine. No vomiting past three days. Patient much brighter. No puffiness of face. Soda bicarbonate, xxx grains, every three hours, for past six days. Normal convalescence.

March 19. Discharged relieved.

CASE XLV.—*Hæmorrhoids.*—D. B.; aged thirty-four years, female; married; housework. Admitted July 8, 1904. Service of Dr. G. H. Monks.

Present Illness.—Discomfort in region of anus for past twelve years. Piles protruded past year on defecation, with pain.

Local Examination.—Several hæmorrhoidal masses about rectum. No ulceration.

July 9. Urine, normal; 1024; acid; no albumen; no sugar; no acetone; no diacetic acid.

July 11, 1904. Operation. Ether. Dr. Kelly. Hæmorrhoidal masses excised and edges sutured with chromicized catgut No. 2.

July 12. Urine passed, normal; 1017; acid; no albumen; no sugar; acetone present; no diacetic acid. No clinical symptoms excepting slight odor of acetone to breath. No further examination made of urine. Normal convalescence.

CASE XLVI.—*Appendicitis, Acute, with Abscess.*—J. H., aged six years; school-girl. Admitted July 10, 1904. Service of Dr. G. H Monks Family History. Negative. Previous History. Negative.

Present Illness.—Four days ago pain in abdomen localized in right side over area the size of palm of hand, just beneath liver extending into lumbar region. Vomiting; odor of acetone to breath. Leucocytes, 14,400. Slight dulness over above area, tenderness and marked muscular spasm.

July 10, 1904. Operation. Ether. Dr. G. H. Monks. Appendix, abscess found just beneath liver. Appendix running up and behind cæcum and retroperitoneally. Appendix gangrenous and perforated; removed. Good ether recovery. Urine passed the day of operation, normal; 1025; no albumen; no sugar; acid. Acetone and diacetic acid present.

July 13. Urine, negative. Patient doing well. No vomiting following operation. Patient slightly dull, otherwise no symptoms. Normal convalescence.

CONCLUSION.

In presenting this series of cases, it is not my intention to attempt to formulate some definite theory for the causation of the condition present. I simply wish to present a series of cases which I feel sure are identical with those reported by other observers.

At present our knowledge of the conditions accountable for the symptoms present, and for the occurrence of acetone and diacetic in the urine, is yet in its infancy. It has been proved experimentally that it is not due to acetone circulating in the blood, as the same condition has been produced experi-

mentally by other substances. The amount of acetone found in the urine is no index as to the severity of the affection. Whether the occurrence of the symptoms is due to a toxic substance acting on psychomotor centres, or due to pressure on these centres, has not been proven. This is only offered as a suggestion as to the causation. That there is some toxæmia occurring is doubtless true; whether it is due to the presence of volatile fatty acids, to the rapid destruction of proteid matter, or to the rapid elimination of the alkalies is impossible to say at the present time.

The object of this paper is to report a series of cases in which the condition has been present in a large proportion; to call attention to the condition as it exists in surgical cases; to show that what has been considered as a rather fatal condition is present mildly in a variety of cases, and to hope that it will stimulate to some extent experimental and clinical investigation.

BIBLIOGRAPHY.

Becker. Deut. med. Woch., 1894, 16, 18; Virchow's Archives, Vol. cxl, p. 1.
Bernert. Zeitschr. f. Heilk., Band iii, Heft. 2.
Brewer. ANNALS OF SURGERY, October, 1902.
Edsall. American Journal of the Medical Sciences, April, 1903.
Guthrie. Lancet, July 4, 1903.
Herter. Chemical Pathology, 1902.
Von Jacksch. Ueber Acetonurie and Diaceturie, Berlin, 1905.
Joslin. Journal of Medical Research, 1904.
Kaulisch. Prager Vierteljahrsschr., 1857, Band xxiv.
Kraus. Alleg. Path. Lubarsch. und Ostertag, Heft 2, 1895.
Kussmaul. Zeitschr. f. klin. Med., Band i.
Lambert. Journal of American Medical Association, October 8, 1904.
Lane. Lancet, January 27 and February 27, 1894.
Landois. Uræmia, 1891.
Magnus and Levy. Arch. f. exper. Path. and Phar., Band xlii.
Müller, J. Arch. f. exper. Path. and Phar., Band. xl.
Muser. Medical Diagnosis, 1904.
von Noorden. Autointoxication, 1903.
Petters. See Kraus.
Rosenfeld. Zeitschr. f. klin. Med., 1895, Band xxviii.
Schwarz. Deutsche Archiv. f. klin. Med., Band lxxvi.
Taylor. American Journal of the Medical Sciences, No. 117.
Tyson. Journal of American Medical Association, October 8, 1904.
Wiesenberg. Proceedings of Pathological Society, Philadelphia, 1904.
Willson. Journal of American Medical Association, October 8, 1904.

GALL-BLADDER AND BILIARY-DUCT SURGERY.[1]

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AMERICAN surgeons have shed a lustre on the development, evolution, and perfection of our art in many fields of surgery, but in no department of surgery has the American mind left its impress in a more forceful manner than in the development and progress of the surgery of the gall-bladder and bile ducts.

Cholecystotomy was first performed by Bobbs, of Indianapolis, in 1867, and while it is probably true that the empyæmic gall-bladder that he incised and drained was adherent to the abdominal wall and the operation may not have been much more serious than opening an abscess, yet it was a step in advance, and was the work of a pioneer, and blazed the way for its establishment as a definite surgical procedure by Marion Sims in 1878, and for the performance of cholecystectomy by Langenback in 1880. Thus it will be seen that the evolution of gall-bladder and bile-duct surgery has occurred within the memory and during the professional activities of the Fellows of this Society, many of whom have contributed their quota to the general advance of our surgical knowledge of this topic. I might mention the investigations of our former distinguished Fellow, the lamented Fenger, in 1895–6 on stone in the choledochus, where it is impacted and immovable, the icterus is marked and persistent, where the stone is movable or of the ball-valve variety, the icterus is variable, a difference in the intensity of the jaundice is observed from day to day, after an attack of pain, from temporary impaction of a movable stone in the duodenal end of the choledochus, the jaundice is markedly increased in the skin and sclerotic. The urine contains more bile and the fæces are more clay colored, when the grasp of the

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duct walls upon the stone is relaxed and the stone is released, so that it no longer completely occludes the duct; it occupies a more dilated part of the duct, and the bile escapes by its side, causing an amelioration of all symptoms and a lessening of the icterus until it again becomes impacted. This alternating current or changing cycle of symptoms will go on indefinitely until terminated by operation or the death of the patient from cholæmia or exhaustion.

Bevan has taught us the exact anatomical relations of the portal vein to the gall-ducts, and suggested an improved sigmoid incision.

Ferguson has shown us how to avoid biliary fistulæ by suturing the gall-bladder to the peritoneum at the upper angle of the wound instead of attaching it to the skin in a dependent position.

Murphy has added to our knowledge of the functions of the gall-bladder, and by the application of his ingenious button has rendered the operation of cholecystduodenostomy rapid, safe, and satisfactory in cases of stenosis of the choledochus.

Ochsner has made the diagnosis of gall-stones much simpler by maintaining that in nearly all cases of gastritis the symptoms in reality are due to gall-stones. He has also greatly reduced the mortality of choledochotomy by stitching the cigarette drain to the open lips of the duct.

McArthur has perfected the technique of operative procedures and shown the limitations of X-ray diagnosis, while Eisendrath has enriched our knowledge of the pathology of infective cholangeitis.

Nearly every other member of the society has in like manner contributed to the sum total of our knowledge of this subject, and I want to congratulate the members of this society for their intellectual activity along the lines of true scientific advancement. They are worthy co-workers with Mayo, Richardson, Deaver, Kehr, Robson, Kocher, and other masters in this domain of surgery.

The advance of knowledge has been steady, rapid, and permanent, and our interest cannot wane when we remember that

gall-stones are present, according to Mosher and the Johns Hopkins tables, in about 7 per cent. of all people, and prove fatal in about 10 per cent. of this number.

Over 12 per cent. of all gall-stone cases show symptoms of common duct obstruction. Stones may be found in the gall-bladder, cystic duct, and choledochus in the same patient, and not infrequently failure to cure the patient by operation has been due to the surgeon overlooking a stone in the choledochus after removing a large number from the gall-bladder. This occurred to me in two of my earlier operations, necessitating its removal at a later period.

In one case, Miss R., aged thirty-six years, operated on by me at the Woman's Hospital, January 22, 1903, for gall-stones causing recurent attacks of biliary colic with mild jaundice, I removed a large number of stones from the gall-bladder and cystic duct, nine from the common duct by a choledochotomy, and for several days afterwards stones of small size were washed out through the wound, one was vomited up, and several were found in the stools, evidently coming down from the hepatic and liver ducts. This patient made a perfect recovery, and has had no recurrence of the symptoms.

Cause.—Gall-stones are formed in the gall-bladder and bile ducts by the agglutination of material precipitated from bile, and are composed of cholesterin, bilirubin calcium, and mixed forms according to Brockbank, in other words, of bile salts and pigments. Anything that tends to slow the bile current causes the precipitation of these salts and biliary sand and the development of cholelithiasis. We no longer depend upon old age, tight-lacing, lack of exercise, ingestion of large amounts of carbohydrates, and the pressure of tumors as the sole cause of the slowing of the bile current, but recognize as equally potent factors in the production of this disease infective micro-organisms that gain entrance to the bile ducts from the intestinal lumen or blood current and induce a catarrh of the ducts, an erosion of the epithelium of the gall-bladder and bile ducts, an increased production of cholesterin, precipitation of

the bile salts, causing or increasing the cholelithiasis, causing ulceration and phlegmon of the walls of the gall-bladder and bile ducts in a manner precisely analogous to what we see in an acute infective appendicitis. The morbific micro-organisms chiefly responsible for these destructive changes are the colon bacillus, the bacillus typhoses, staphylococcus and streptococcus; obstruction in the common or cystic duct preventing the escape of these infective micro-organisms causes the most rapidly destructive pathological changes in the mucosa and wall of the duct or gall-bladder; long-continued irritation from an imprisoned stone or stone induces malignant disease of the gall-bladder or common duct, hence the frequency of carcinoma in this region; long-continued icterus in an elderly patient should awaken a suspicion of carcinoma of the gall-bladder or ducts, as a sequence of unrelieved cholelithiasis. Irritation of the outlet or neck or mouth of a viscus surrounded by circular muscular fibre subject to alternate contraction and dilatation due to the passage of the contents of a viscus, or irritation of the orifice of a duct is very prone to induce carcinoma, as in the pylorus, the cervix uteri, the rectum, or the gall-bladder.

The gall-stones may be single or multiple, facetted or smooth, sometimes of mulberry appearance, and vary in size from a grain of sand to a hen's egg, and green, brown, yellow, or black according to the arrangement of the bile pigment entering into their formation, faceted stones being found in the gall-bladder and smooth ovoidal ones in the choledochus, as a rule.

Symptoms.—The formation of a stone requires several months and is preceded by gastro-intestinal catarrh, constipation, flatulence, impaired appetite, discomfort in the epigastrium and right hypochondrium, sallowness, slight icterus, scantiness of urine with increase of bile and urea in the urine, sour stomach, tenderness over the gall-bladder, and when there is bacterial invasion of the viscus moderate temperature and an occasional chill with bilious colic and headache.

Typical gall-stone colic soon becomes established, and if the obstruction is in the common duct there is the sudden onset of agonizing pain, paroxysmal in character, lasting from a few

hours to a couple of days, originating in the region of the gall-bladder and radiating to the back and under the right shoulder-blade, often accompanied by nausea and vomiting, especially at the beginning of the attack. It may terminate suddenly or gradually. If the attack lasts more than twenty-four hours there is usually jaundice. If the stone passes through the common duct there is immediate relief and the stone will be found in the stool; if it is arrested in the common duct in the diverticulum of Vater we have the chronic form, with frequent repetitions of the clinical picture I have painted, until the patient is relieved by operation, or dies from cholæmia or exhaustion.

Many of these cases are treated for years by medication, diet, massage, baths, exercise, olive oil, a course at Carlsbad or West Baden without permanent benefit, and the delay usually causes serious complications of circumscribed peritonitis, dilatation, and infection of the gall-bladder and ducts, phlegmon, perforation, circumscribed abscess, empyæmia of the gall-bladder, universal adhesions to adjacent viscera, and the obliteration of normal anatomical landmarks that immensely increase the difficulties of the operation and add to its mortality. The results of delay and repeated attacks cause complications that are strikingly analogous to those of appendicitis.

I desire to appeal strongly for early diagnosis, shorter period of medical treatment, early surgical intervention, and a lessened mortality for a disease that should be recognized as a surgical affection and only amenable to surgical treatment. The former dictum of three months' medical and dietetic treatment is altogether too long, and leads to unnecessary suffering, serious complications, and a higher mortality.

Uncomplicated cholecystitis and choleliathisis give practically no mortality under prompt and proper surgical treatment by incision, evacuation, and drainage. Cholecystotomy, cholecystectomy, and choledochotomy should always be followed by tubular and capillary drainage for some days after the operation, a cigarette drain should be attached to the lips of the wound in the choledochus in all common duct stone opera-

tions. I believe it is safer to drain all cases, as imprisoned bile always contains infection germs, and you lessen the cholangeitis and cholæmia more rapidly in this way.

Waring gives the following indication for operation:

1. "The presence of a tumor in the abdomen which appears to be an abnormally distended and large gall-bladder.

2. "The existence of jaundice, which is persistent together with other signs and symptoms which point to complete obstruction of the common bile-duct or the common hepatic duct.

3. "The occurrence of successive paroxysmal attacks of biliary colic, with short intervals between the individual attacks, which are lowering the general health of the patient, inducing a state of general exhaustion, and are not amenable to medical measures.

4. "Symptoms of localized inflammation in the region of the gall-bladder which are associated with the occurrence of attacks of biliary colic.

5. "The occurrence of acute peritonitis which is probably due to perforation of the gall-bladder or one of the biliary ducts and escape of calculi and purulent matter into the peritoneal cavity."

The soundness of the views expressed in this paper are exemplified by the following illustrative cases where early operation was declined or not possible for some reason:

Case I.—A patient came to my office to-day presenting the classical clinical symptoms of stone in the common duct, with a history that is familiar to all of you. Mrs. M. K., aged fifty-two years, married, Irish, has suffered from indigestion and flatulency, more or less, all her life. About six years ago she said she was bilious, and was treated by Drs. Davis and Johnson for six weeks in Mercy Hospital. Prior to this she had frequent attacks of bilious colic. She has had chills and has vomited every few days during the past year at intervals. Jaundice has been quite marked, the color varying with the severity of the attack. She complains of marked itching of the skin. There is yellowness of the conjunctiva, and tenderness over the region of the gall-

bladder. I told her she had gall-stones, and should have an operation. Like many patients who come to us with surgical affections that require prompt surgical intervention, she said she did not want to be operated on, but wanted something to stop the itching of the skin and take away the yellow color; in other words, to relieve the obstruction in the common duct that produced the symptoms. Operation was refused. She wanted to talk with her father. Her father is eighty-two. They live together, and she has no money.

I simply cite this typical case which illustrates the difficulties of carrying out the treatment I advocate in this paper, namely, early operation soon after the diagnosis has been made, say within a few weeks after we are certain of the pathological conditions present.

CASE II.—Another case that illustrates in a striking manner the changes that take place is that of Dr. G. M. B., aged fifty-six years, of Benton Harbor, Michigan, who consulted me early in August, stating that for a number of years he had suffered from stomach trouble; he had acute indigestion; he had to be careful what he ate. He had a great deal of flatulency and tenderness at the pit of the stomach. From my knowledge gained from Dr. Ochsner's experience with these gastric symptoms, I said to him, "Doctor, you have gall-stones." "Oh, no, I have not gall-stones; I have stomach trouble, and my liver is enlarged." For two or three years he has suffered from attacks of biliary colic, and his general health has been much impaired. He attributed this always to acute gastritis and liver complications. These symptoms were progressively increasing. He had two or three severe attacks, with marked loss of flesh. He lost something like twenty pounds. He came to my office accompanied by his wife on the 25th of August, just after an unusually severe attack. At this time he had a rapid pulse; temperature of 102° F.; marked tenderness over the gall-bladder. Indeed, the region of the gall-bladder was so tender that he could scarcely be touched, and he presented the appearance of a haggard, old, sick man. He had aged rapidly during the last few weeks. He had become stooped. I told him that he must have an immediate operation; that he had gall-stones; that infection of the gall-bladder had taken place, and

that an immediate operation was the safest and best thing for him. Almost in the face of his violent protest, I called a cab and sent him to the West Side Hospital, and the next day operated. In making a long incision through the outer border of the right rectus, I came upon a large mass of adhesions. The omentum was adherent to the gall-bladder, liver, and colon. There was a mass of adhesions covered and walled in by the omentum, and after packing off the abdominal cavity with strips of gauze, I carried my finger under the lower border of the omentum, separated the adhesions a short distance, when I opened into a large abscess, from which six or seven ounces of thick pus escaped. This was mopped out from time to time with gauze sponges, and the abscess cavity was thoroughly dried out. I then carried my finger into the abscess cavity and found a perforation of the gall-bladder, an opening into which the finger could be readily introduced, and with the finger introduced I found and removed five mulberry calculi. I do not see many of them, but these presented the typical appearance of a mulberry in every respect. After these were removed, a large glass drainage tube was introduced, and iodoform gauze packed around the tube with strips brought out through the wound. The wound was closed in the ordinary way and the patient put to bed. He made an uninterrupted and rapid recovery. The tube was left in three or four days, and at the end of two weeks the wound was practically closed, patient leaving the hospital about two days later, and had no untoward symptoms. He has steadily improved. He is now attending to his practice in Michigan.

This case illustrates the pathological changes that take place from delay and error in diagnosis.

CASE III.—G. F. S., aged sixty-two years, was seen by me March 15, 1903. He had suffered from a typical attack of biliary colic in 1900, when a large quantity of biliary sand was passed, with complete relief of the symptoms. At that time he had elevation of temperature and pain, and under catharsis and flushing of the intestine, as well as washing out the stomach, etc., he was completely relieved. The large quantities of biliary sand were the cause of the trouble. During the present attack, in March,

1903, he complained of pain and tenderness in the region of the gall-bladder; he had a pulse of 96; temperature, 102° F.; tongue coated; breath foul; bowels constipated; no icterus, and the usual marked tenderness over gall-bladder. A diagnosis of acute infective cholecystitis was made, and an operation for draining the gall-bladder was advised. This was postponed by the patient from day to day, although urged at each daily visit, until the night of the 21st of March, 1903, at midnight, I was summoned in great haste, and found he had a chill. I telephoned to Dr. Wyllys Andrews, expecting on examination to find perforation of the gall-bladder, with the necessity for an emergency operation. Everything was prepared a day or two before that, so that we were ready, and made an immediate operation at the house. I made an incision through the right rectus, and immediately upon opening the abdomen found a condition similar to that in the case of Dr. B., in which I described a mass of adhesions, the omentum being adherent to the liver surrounding the gall-bladder, and little by little there was an escape of a quantity of muddy, offensive pus, bile-tinged, and flaky. This was mopped out. A phlegmon of the gall-bladder wall was found, and on lifting up the adhesions we found numerous gangrenous spots surrounding a large perforation. I incised the gall-bladder freely. No gall-stones were found in this case, but simply infected, inspissated, offensive bile. The patient went along and made good progress towards recovery until the eighth day, when on turning over in bed he suddenly cried out with pain in the right lung, and complained of dyspnœa. He became cyanosed. Dr. Andrews and Dr. Edwards were present with me at the time, and the sudden onset of these serious symptoms evidently was due to a clot, a pulmonary embolism. In ten minutes the patient was dead, doubtless from a clot occluding the pulmonary vessel. Had this patient consented to an operation on the 10th, the 16th, or the 18th of March, his life might have been saved. That is to say, early drainage of the infected gall-bladder would have lessened the probabilities of such an unfortunate complication and termination as took place.

Drainage opening was lined with granulations and healing rapidly. No post-mortem could be obtained.

Case IV.—Mrs. L., aged seventy-one years, had attacks of biliary colic at intervals for several years. Tenderness and disten-

tion of the gall-bladder noticed in March, 1904; marked icterus, with vomiting and constipation. There was gradual emaciation. A diagnosis of obstruction of the common duct and infective cholangeitis was made. October 4, 1904, I succeeded in obtaining consent for an exploratory operation, and with the assistance of Dr. Frankenthal, at the Woman's Hospital, I made an incision and came down upon an immensely dilated gall-bladder. The gall-bladder contents consisted of sixteen ounces of turbid, tarry bile, with a great many flakes, and some small gall-stones. It was one of the largest gall-bladders I have ever drained. She was in a very bad condition. No stone was discovered in the common duct, but the neck of the gall-bladder was surrounded by a number of small tumors. There were three or four irregular tumors which compressed the common duct. It was a case of carcinoma of the gall-bladder, and on account of the condition of the patient nothing was done except to drain the gall-bladder. She died two days afterwards, vomiting a sanguinolent material, with regurgitation from the stomach. During the performance of the operation there was noticed a laceration of the liver to which the immense gall-bladder was attached, and this small rent was made in the liver by a wide pair of forceps; it was stitched with catgut, and no hæmorrhage occurred after this. Whether the oozing was due to the cholæmic condition, I do not know. It is probable that it was. We know that in these cases we have a persistent oozing from the mucosa or from any wound in the gall-bladder. The blood does not coagulate, and the oozing continues until the case terminates fatally, with more or less vomiting and exhaustion. For nearly a year this patient was urged to undergo operation, but declined.

Case V.—Mrs. R., aged sixty-seven years, was referred to me by Dr. Byford, with a diagnosis of stone in the common duct. I concurred in the diagnosis. She gave a history of having suffered from frequently occurring attacks of biliary colic, with catarrh of the stomach, and that she had these attacks of catarrh of the stomach recur at intervals during the last fifteen years. In June, for the first time, she had a typical attack of biliary colic, and was somewhat jaundiced at the time, and since June, up to the time of operation, she had about once or twice a week severe attacks. Ten days before she came to the city she had an unusually severe attack, which was accompanied by

a chill, elevation of temperature, marked jaundice, and her physician, who was a son-in-law, brought her to the city for operation. There was marked tenderness over the gall-bladder. Operation was performed October 21, at the Woman's Hospital, with the assistance of Dr. Byford. The gall-bladder was found to be greatly enlarged, containing turbid bile and fifteen small stones. These were round and not faceted. There was one large round stone found in the common duct of the ball-valve variety, and which was doubtless responsible for the recurrent attacks. As I opened the gall-bladder and cystic duct, the stone did not seem so large, as I could push it upward through the cystic duct and extract it through the gall-bladder. I thought, as it lay in a dilated pouch in the common duct, I could readily extract it, avoiding an incision in the common duct, but in pushing it up it got away from me, and passed from the common duct into the hepatic duct, and I was unable to bring it down. I was in a quandary. After a few moments' deliberation, I made an opening in the common duct at the pouch occupied by the stone before, and expected to pass up a small forceps and extract it, but I was unable to do so. The stone eluded the grasp of the forceps, so I stitched in a large rubber drainage tube, passing it up through the opening in the comon duct. I put a glass drainage-tube in the gall-bladder. I packed some gauze around the tube in the common duct and closed the wound. The patient gained right along, and she is now fully convalescent. The stone being found on the dressings on the sixth day, when the common duct drain was removed.

Case VI.—I wish to mention another case to show how we have improved in our knowledge of gall-bladder surgery in the attachment of the gall-bladder when cholecystotomy is done. Mr. S., aged sixty-one years, was admitted to Wesley Hospital in 1899 with gall-stones, and had been operated on about a year previous to this by another surgeon for gall-stones. He was admitted to my service, and I found he had a large biliary fistula following the operation at which the gall-stones were extracted. The gall-bladder had been stitched at the dependent portion of the wound to the skin instead of to the peritoneum, leaving a large biliary fistula with patulous mouth. In this case I reopened by the side of the gall-bladder, resecting about one-third of it and using circular purse-string catgut sutures around the upper part of the wound, attaching the gall-bladder to the upper angle of the

wound to the peritoneum, and secured permanent closure in a couple of weeks.

CASE VII.—The patient is fifty-five years of age, married, adjuster by occupation, and was seen in consultation on the 8th of October, 1904, suffering from infective cholecystitis, empyema of the gall-bladder, ulceration, with symptoms also of appendicitis. He was in such a bad physical condition that the operation was delayed. He had an acute general peritonitis. The day I saw him his abdomen was immensely distended and tympanitic. He was vomiting. The whole right side of the abdomen was dull and tender on pressure. He was put upon starvation treatment; nothing given him by mouth, the stomach was washed out, and he was given three ounces of normal salt solution and an ounce per rectum every three hours. This treatment was continued for about ten days; vomiting and tympanites disappeared. His condition improved so much that we felt justified in operating. On account of agglutination on the right side of the abdomen of the intestines, gall-bladder, and appendix, I thought, instead of opening the general abdominal cavity, I would go down through this mass and do an extraperitoneal operation, and, expecting to find an abscess and all kinds of complications, I immediately came in contact with what seemed to me like a fæcal collection of two or three pints, walled off from the general cavity, lying between the small intestine and gall-bladder, and I could not tell anything about the anatomical outlines of the case. They were not clear. The cavity was walled off to the inner side by coils of intestine, on the outer side by the abdominal wall. There was a large amount of offensive, purulent, yellowish fæces, also a large amount of pus and some bile. This was washed out. I then introduced my finger and found an enlarged, irregular-shaped abscess cavity, with free communications with the intestine and with the gall-bladder. The cavity was washed out. I took a long forceps, made a lumbar stab, establishing through-and-through drainage, putting in a large rubber tube, and irrigating two or three times a day. Five or six days after this the man's condition improved very materially, and six days, I think, after the operation was performed, a gall-stone appeared. Since then, nearly every day he has been flushing out gall-stones. Bile now flows freely. The fæcal discharge has entirely disappeared, and we now have a biliary fistula. The man is still in a some-

what critical condition, although his recovery is certain. The daily irrigations are being kept up. Unquestionably he had empyema of the gall-bladder; the adhesions ruptured, or there was a perforation of the gall-bladder; also a perforation or ulceration communicating with this abscess cavity and the lumen of the bowel, so that there was a discharge of fæcal matter with bile and gall-stones.

These cases are cited to illustrate the dangers of delay and the complications that arise from postponing a necessary surgical operation to a time when it is done as a last resort.

VOLVULUS OF THE JEJUNUM.

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Miss M. W., an adult, had had dyspepsia for several years; otherwise her health had been good. After eating a boiled dinner of cabbage, corned beef, and potatoes, she had severe "cramps" in the abdomen. These "cramps" resembled "colicky pains." Moving about in the bed and doubling herself over—that is, drawing her knees up to her abdomen—seemed to temporarily afford relief, but the colicky, crampy pains continued. These colicky, crampy pains were intermittent, easing up a little and then recurring with renewed force. She vomited, she had extreme nausea, she had many loose movements from the bowel. None of these movements contained blood. The vomiting and the "dry heaving" continued all night. I saw her upon the third day of the attack. She looked sick, she presented a peritoneal facies, her features were drawn, the angles of her mouth and alæ nasi were depressed, there was a little black vomitus on the lips and chin, the abdomen was distended, the umbilicus was flush to the level of the abdominal wall, the abdomen was tympanitic throughout. No tumor could be felt.

Operation discovered an almost black coil of the jejunum, about two feet long, twisted at its mesenteric attachment. (Fig. 1.) Upon untwisting this volvulus, its exact extent was determined. It was found, as is seen in the photograph, to extend up to within about two inches of the beginning of the jejunum and thence down for two feet. (Fig. 2.) The condition of the patient precluded the possibility of further interference. The abdomen was closed and the woman died.

This case serves to illustrate the very great importance of a careful, discriminating analysis of abdominal pain. Had this case been operated at the onset of the attack, the chances of recovery would have been good. The several hours' delay caused the death of the bowel, tremendous shock to the individual, and

FIG. 1.—Volvulus of jejunum seen untwisted, but in same situation as found at operation.

FIG. 2.—Thrombosis of the mesenteric vessels due to *volvulus* of the jejunum. Note upper boundary of gangrene of gut close to jejunal origin. Omentum and transverse colon drawn upward, showing mesocolon and beginning of jejunum.

precluded the possibility of surgical relief. The pain in this case was typical of a mechanical obstruction. It was not possible to make a diagnosis of volvulus or of a band, but that there was a mechanical obstruction from some cause there was no doubt.

This case is recorded because the volvulus of the jejunum was high, which is unusual. I suppose that the shock from the high situation of the volvulus must have been great, and decidedly greater than from a volvulus seated in a lower portion of the small intestine. In a case with such a high situation of the volvulus arises the question, What is the best surgical treatment? Had the case been seen early and had the bowel been viable, a simple untwisting of the volvulus would have been all that was necessary, but with the bowel gangrenous so close to the jejunum, it was a question as to the wisest operative procedure. A resection of the gut, an anastomosis with a Murphy button, or a resection of the gut and closure of the jejunum at the proximal end, and an anastomosis of the distal jejunal end into the duodenum might have been the best procedure.

After dividing the gut at the jejunal origin, it might be possible to divide the peritoneal reflection and to free the last part of the duodenum sufficiently to facilitate the use of the Murphy button. I shall do this experimentally upon the cadaver in order to determine if this is feasible.

The pathological report from the Pathological Laboratory at the Massachusetts General Hospital, so far as the case surgically is concerned, was as follows: Obliterating thrombosis of the superior mesenteric vein; hæmorrhagic infarction of a portion of the jejunum. The first portion of the jejunum over a distance of about seventy centimetres is dark purple in color, and its mesentery is thickened and purplish in color. At its upper and lower margins it is rather sharply marked off from the duodenum and from the remaining portion of the jejunum, the lower line of demarcation being less sharp than the upper. (Fig. 2.)

OPERATIONS ON THE LOWER ENDS OF THE URETERS BY THE INGUINAL EXTRAPERITONEAL ROUTE UNDER LOCAL ANÆSTHESIA (COCAINE).

A REPORT OF THREE URETEROVESICAL IMPLANTATIONS AND THE REMOVAL OF A URETERAL CALCULUS.

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OF BALTIMORE,

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PATHOLOGICAL conditions of the lower end of the ureter usually impair its function, either by interfering with the passage of urine from the kidney to the bladder or else permitting a reflux of urine from the bladder into the kidney. In either instance there is a damming back of urine into the pelvis of the kidney with a consequent hydronephrosis. If the ureter is thickened and inflamed, its lumen may not become greatly enlarged, because the pressure is not sufficient to stretch its thickened walls, as may be frequently seen in a tuberculous ureter, and also if the ureter is embedded in dense tissue its expansion will be interfered with. On the other hand, a stricture (from any source) of the lower end of the ureter usually causes a hydroureter, which may become tortuous, and the natural dilatations of the ureter may become greatly enlarged as contrasted with the natural constrictions which may be little or not at all affected by the distention of the ureter. The distention and tortuosity of the ureter may cause it to break through the tissue about it, *i.e.*, its imperfectly formed sheath,[1] thus giving rise to hernial formations, the ring of the hernia being formed by the intact sheath at either end of the point of rupture. These hernial rings of the ureteral sheath may cause the so-called valves sometimes found in these cases. The function of the kidney whose ureter is diseased is not only interfered with, but

the organ is in a condition of lowered local resistance, and sooner or later the kidney is apt to become infected either through organisms carried there by the circulating blood or from others which may gain access to the lumen of the ureter and reach the kidney through the damming back of urine caused by the ureteral stricture.

We may speak of the condition brought about by a diseased ureter as that of renal insufficiency. This insufficiency may be *relative*, which is especially true if only one ureter is diseased and the other being intact is sufficient; or even if both are involved, the two kidneys together may be able to maintain renal function sufficient for the individual. In this condition there is renal sufficiency, and the term *relative renal insufficiency* is used only in a comparative sense. In other cases where both ureters are involved and *renal compensation* or *recuperation* has not taken place, there exists a condition of *renal insufficiency* which may be temporary or permanent. The compensatory ability of the kidney is a very interesting condition, and we are all familiar with the hypertrophied kidney resulting from compensatory changes which have taken place in one kidney after the other has been removed or its function has been impaired. Of still greater interest is the recuperative power of the kidney. Temporary obstructive anuria may occur and yet the individual may live, and especially interesting are those cases in which both ureters have been accidentally ligated for from twenty-four to seventy-two hours, and where, after the ligatures have been released or the ureters have been reimplanted into the bladder, the kidneys have resumed their function and the individual has recovered, as have been reported by Zweifel,[2] Purcell,[3] Markoe and Wood,[4] Neumann,[5] Bailey,[6] and I have seen one such case. It is evident, then, that the kidney has great recuperative ability, and this knowledge should influence the surgeon in the operative treatment of such conditions. I am conducting a series of experiments along these lines, and one dog lived and was well five months after the removal of its normal kidney, there being apparently perfect renal sufficiency from a kidney whose ureter had been

ligated for one week, and then the distended ureter was resected and reimplanted in the bladder; and after waiting one month for its kidney to recuperate, the hypertrophied sound kidney was removed. Experiments along these lines and also clinical experience teach us that the kidney has great recuperative ability, and that operations on the kidney should be more conservative.

We must consider two general classes of diseased conditions of the lower ends of the ureters:

I. Those cases with absolute renal insufficiency demanding an immediate operation, in which nephrotomy plays such a prominent rôle, in order to relieve a kidney with or without infection, whose ureter has become partially or completely occluded. (I have purposely omitted the postoperative anuria due to occlusion of the ureters by ligatures when the operation of choice should be the release of the ureter.) In this first class of cases, the operative treatment is temporarily to relieve the condition, and nephrotomy seems to be the operation of choice in most of these cases. It may be done under nitrous oxide anæsthesia, as recommended by Bevan,[7] and as has been done in this hospital; or, as the operation is of short duration, it may usually be done under ether or chloroform. Two of the three cases reported in this article had bilateral nephrotomies in order to relieve the renal insufficiency existing at the time.

II. The second class of cases are those of relative renal insufficiency, in which the cause of the trouble still exists, and a temporary relief by a nephrotomy may or may not have been done. In order to cure the patient, the cause of the trouble must be removed, the ureter resected and reimplanted in the bladder, or a stone removed which may be obstructing the lumen of the ureter, or some other operation done to relieve the local condition. These operations usually take a long time and require exacting, careful work, in a patient with an unstable renal sufficiency, and on this account sometimes ill suited to undergo a prolonged general anæsthesia.

If certain operations may be done well without causing the patient much discomfort or pain, a local or general anæsthetic

may be dispensed with for these operations. This proposition may be carried still further; if in a long operation certain steps are painful and others are not, why should we not use a temporary anæsthetic, such as nitrous oxide, or a local anæsthetic, as cocaine, for those steps of the operation which cause pain, and *omit* an anæsthetic when it is not necessary? It becomes very evident that a knowledge of the sensibility of the field of operation to pain should influence the surgeon in choosing an anæsthetic, especially if a general anæsthetic is contraindicated.

In all three cases, with four operations under local anæsthesia, about to be reported, the condition was that of relative renal insufficiency due to a diseased condition of the lower ends of the ureters.

In the first case the condition was that of bilateral ureteral stricture with ureteral inefficiency, *i.e.*, the diseased lower ends of both ureters had been converted into sinuses, which interfered with the passage of urine from the kidneys to the bladder and were also unable to prevent a reflux of urine from the bladder into the kidneys.

In the second case, the lower ends of both ureters had been dissected free in a more radical operation for carcinoma cervicis uteri with a resulting unilateral ureteral necrosis, giving rise to a ureteral fistula. As the lower ends of both ureters had been freed, the function of both may have been interfered with, at least temporarily. The necrosis of one ureter gave rise to a ureteral fistula with consequent formation of a ureteral stricture, and thus impairment of the function of the kidney.

In the third case there was bilateral renal infection associated with a cystitis. Double nephrotomy had temporarily relieved the condition. A calculus which partially occluded the right ureter was diagnosed by means of the wax-coated catheter and X-rays.

Case I.—Mrs. T. M., aged thirty-two years. Gyn. Nos. 9495, 9705, and 11,101½. (Referred to in a previous communication.[8])

Diagnosis.—Double pyonephrosis with double ureteritis, stricture and inefficiency of the vesical ends of both ureters per-

mitting a reflux of urine from the bladder into the pelvis of the kidneys.

Operation.—Resection and implantation of both ureters into the bladder, by the inguinal extraperitoneal route. September 8, 1903, and November 11, 1903.

Anæsthetic.—Cocaine (Schleich's Solution). Contraindications to a general anæsthetic. Renal insufficiency. Patient had been given a general anæsthetic on previous occasions, and after the last operation she not only left the table in bad condition, but the convalescence was very slow, being marked by prolonged nausea, vomiting, and a rapid pulse.

History of Case.—*Family History.*—Negative; no history of tuberculosis.

Personal History.—Negative; always well until present illness. Married seven years; two para (five and two and a half years), one miscarriage before the birth of her first child. Labors normal; no history of puerperal fever.

Present Illness.—Began before the birth of her first child five years ago, with frequent micturition, without pain or hæmaturia. Following the birth of the child she had hæmaturia, with pain and burning on voiding. Ever since the onset of her illness, over five years ago, the patient has been troubled with her bladder, the difficulty being at times slight, interfering with her work but little; and at other times severe, forcing her to go to bed. Recently, the trouble has been getting worse, her urine has been purulent, at times ammoniacal, and her general health has been poor.

Patient was first admitted to this hospital in March, 1902. A diagnosis of double pyonephrosis was made. Tubercle bacilli were never found in the urine; the patient was given tuberculin, but no reaction followed. Cultures taken from each kidney showed colon bacilli. At this time both ureters could be distinctly palpated and were thickened and tender. The ureteral orifices appeared like two large funnels. The patient was treated by rest and frequent irrigations of the pelves of both kidneys through renal catheters. She left the hospital, June 3, 1902, improved, and was readmitted one week later, and remained in the hospital one month, during which time the pelves of both kidneys were irrigated three times a week with a solution of silver nitrate, 1 to 500, followed by sterile water.

After leaving the hospital the patient remained home for

three months, and was readmitted October 5, 1903. Apparently the treatment in the hospital had given her temporary relief only. The kidneys were irrigated, as on previous admission, until December 22, 1902, when an incision was made into the left kidney by Dr. Kelly, and a vesicovaginal fistula was also formed. This was done because the bladder had become markedly inflamed and it was impossible to catheterize the ureters. A month later the vesicovaginal opening was enlarged and a suprapubic incision was made in order to give the bladder freer drainage. At the end of six months the patient's condition had improved but very little. There was evidently a stricture of both ureters, for the left could be catheterized only with great difficulty and the right not at all. Cultures from the left kidney showed a pure culture of B. pyocyaneus instead of the B. coli communis as at the previous admission. The patient desired to go home, but before closing the vesicovaginal fistula in order that she might go, I determined to ascertain whether or not it would be safe to do so.

On June 7,, 1903, a catheter, which was connected with a funnel by rubber tubing, was inserted into the bladder, and the vesicovaginal opening was closed by a finger inserted into the vagina. Fluid was now poured into the funnel, and thus the bladder was filled until the distention caused discomfort but no actual pain. The patient stated that she could feel something passing up her ureters into her kidneys, which caused pain in both kidneys. The fluid was withdrawn from the bladder. Three hours later the patient's temperature rose to 102.6° F. She had a chill and severe pain in the region of both kidneys. The elevation of temperature and pain lasted four days, and gradually subsided. It was evident that the distention of the bladder caused a reflux of the bladder contents into the ureters, thus interfering with the function of the diseased kidneys and causing a reinfection of the kidneys, with the clinical symptoms of pain and fever. A closure of the vesicovaginal fistula would give rise to the same condition, for the diseased vesical portions of the ureters were rigid tubes, and were unable to prevent a reflux of urine when the bladder was distended.

June 26, 1903, the right kidney was incised by the author making a nephrostomy.

July 20, 1903, I resected the lower end of the left ureter and reimplanted it into the bladder by the extraperitoneal route

under general anæsthesia. (Chart I.) Following the operation, the patient was very ill, with nausea and vomiting which lasted irregularly over a period of nearly two weeks, and a rapid, weak pulse. Patient recovered; ureteral orifice easily catheterized. Operation apparently successful, but later proved not to be. (See notes following the next operation.)

Because the patient had been so ill after the last operation and also after other operations referred to in this article, I decided to resect and reimplant the right ureteral orifice under local anæsthesia.

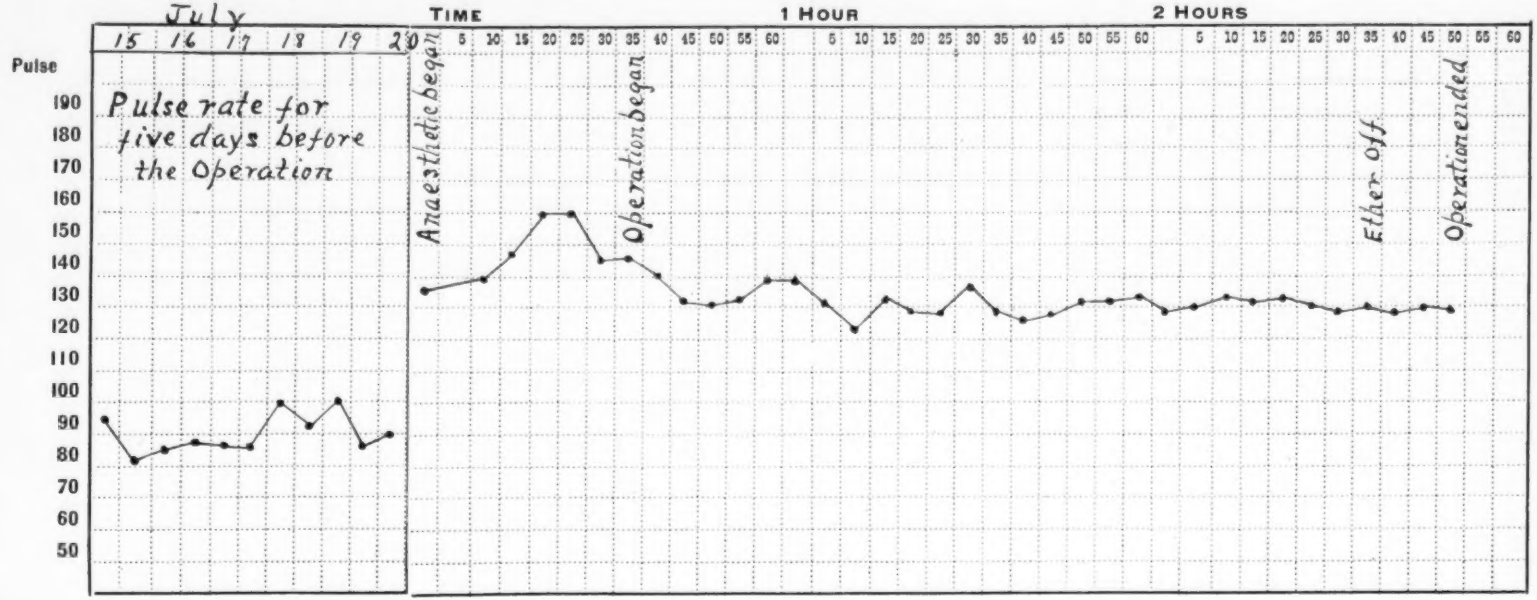
Resection of the Right Ureter and its Implantation into the Bladder by the Inguinal Extraperitoneal Route, through a low McBurney Incision, for Inefficiency of the Ureteral Orifice. September 8, 1903. Duration of operation, five hours and fifteen minutes. Anæsthetic, Cocaine (Schleich's Solution), where necessary.

An incision was made through the skin, infiltrated with Schleich's Solution, from a point three centimetres mesial and above the anterior superior iliac spine and extending down to the insertion of the rectus muscle in the pubic bone. The aponeurosis of the external oblique muscle was split open and the deeper muscles were exposed, and the fibres separated by blunt dissection, thus giving rise to a "gridiron incision" similar to McBurney's incision, and exposing the peritoneum. The deep epigastric vessels and the round ligament were cocainized, clamped, cut, and ligated.

The peritoneum was now dissected free from the abdominal wall and side of the pelvis, and the external iliac vessels were exposed and the *hypogastric artery. The latter served as a useful guide to the uterine artery and the ureter.* The ureter was found to be much thickened, about one and a half centimetres in diameter, and adherent to the surrounding tissues. The lower pelvic portion of the ureter was dissected free, it being necessary to clamp, cut, and ligate the uterine artery in order to accomplish this. The ureter was freed down to the bladder, where it was cocainized and cut across. A sound was introduced into the bladder through the urethra and the bladder wall was pushed out and opened near the end of the ureter. The end of the ureter was split into two flaps, and a catgut suture was passed through the end of the ureter and into the opening in the bladder and out of

CHART I.

Name.—Mrs. T. M. Age, 32. Gyn., Nos. 9495, 9705, and 11,101½.
Date.—July 20, 1903.
Diagnosis.—Inefficient ureteral orifices, permitting a reflux of urine from the bladder into the kidneys.
Operation.—Resection of the ureter (left) and its implantation into the bladder by the inguinal extraperitoneal route.
Anæsthetic.—Nitrous oxide and ether.
Amount of Anæsthetic.—Nitrous oxide to start, ether about 340 grammes.



Anæsthetic well taken; pulse rather weak throughout the operation. Convalescence marked by nausea and vomiting, lasting irregularly for nearly two weeks after the operation; pulse rapid, poor quality; patient very ill. Notice the even pulse-rate after patient is completely under anæsthetic. Compare with Chart III. Result, patient recovered; the ureterovesical implantation healed, but the ureteral orifice was still inefficient, permitting a reflux of urine from the bladder into the ureter.

Chart II.

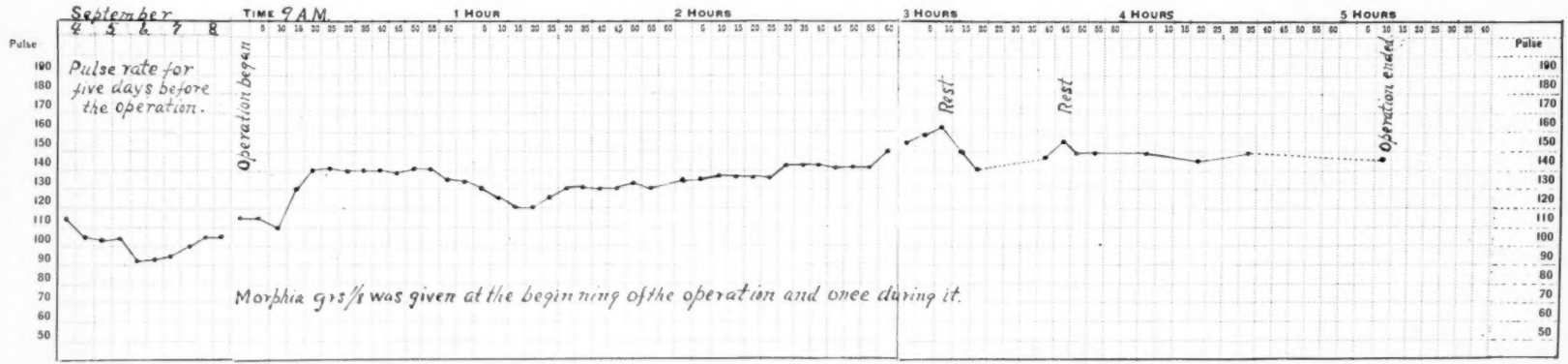
Name.—Same patient as Chart I.

Date.—September 9, 1903.

Diagnosis.—Inefficient ureteral orifices, permitting a reflux of urine from the bladder into the kidneys.

Operation.—Resection of the right ureter and its implantation into the bladder by the inguinal extraperitoneal route, through a modified McBurney incision down to the peritoneum.

Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, and then where necessary.



Traction on the parietal peritoneum was the main source of pain during the operation. In order to expose the field of operation, it was necessary to push aside the freed peritoneum; this caused pain; any change in position must be gradual and done carefully in order to avoid unnecessary pain. The effect of the operation was that of hard work, the patient felt "tired out." Had more frequent "rests" been made, the "work" would have been easier and the pulse would not have maintained such an even high rate, but would have been irregular. See Charts III, V, and VI. Result, operation was successful, the ureteral stricture was cured, and the ureteral orifice became efficient, a reflux of urine being impossible.

the urethra, and the ureter was thus drawn into the bladder, so that it protruded over one centimetre into the cavity of the bladder and remained there, while the ureter was sutured in place with fine silk, taking care to suture the bladder wall *to the ureter* and *not* around it, so as to avoid a stricture.

A piece of rubber tubing was placed transversely across the vaginal orifice, and the catgut suture which had been passed through the end of the ureter and out through the urethra was tied around it in order to relieve the tension on the sutures fastening the ureter into the bladder. Gauze drains were placed down to the seat of the operation and the incision was partially closed.

Any procedure which made traction on the parietal peritoneum caused pain, as the separation of the peritoneum from the sides of the pelvis, traction on the ureter and freeing it, while pinching the ureter caused little or no pain. The uterine artery was clamped, cut, and ligated without causing pain. Pushing out the greatly thickened bladder with the sound introduced through the urethra and making the incision into its walls caused pain, while the actual suturing of the bladder to the ureter did not seem to cause pain. As the exposure of the field of operation required pressure on the parietal peritoneum, which had been freed from the abdominal and pelvic walls, this had to be done very carefully, and any change in position must be made gradually in order not to cause any unnecessary pain. The most painful part of the operation was suturing the abdominal incision at the close of the operation. The patient stood the operation very well. The pulse was rapid during the operation, at one time reaching as high as 160. The maintained high pulse-rate was due to the absence of frequent rests. Had there been more rests, the pulse curve would have been irregular, as in Chart III of the same case, where rests of from two to five minutes were very frequent; also the operation would have been much easier for all concerned.

The effect of the operation was that of hard muscular exercise, and the patient felt tired out. The general condition of the patient, aside from the fatigue, was the same after as before the operation. The convalescence was as rapid as might be expected in one recovering from the effect of several hours' hard work or from a long time spent in a dentist's chair. *The operation was a success.* The implantation healed, and it was impossible to force fluid from the bladder into the right kidney, as shown by

the following. On November 11, 1903, the bladder was distended with a solution of methylene blue, and the patient stated that she could feel the fluid pass up the left but not up the right ureter. The bladder was now washed out with sterile water, and on making a cystoscopic examination the blue fluid could be seen coming out of the left but not from the right ureteral orifice. The ureters were catheterized, and the blue fluid was obtained from the pelvis of the left kidney but not from the right, thus demonstrating that the left ureteral orifice was still inefficient and permitted a reflux from the bladder, while the right ureteral orifice was functionally normal. The right ureter, having a diameter of fully one centimetre, projected into the cavity of the bladder for a distance of nearly one centimetre, while the orifice of the left one formed a funnel-shaped depression in the bladder. It was decided to again resect the left ureter and to try to imitate the condition present in the right.

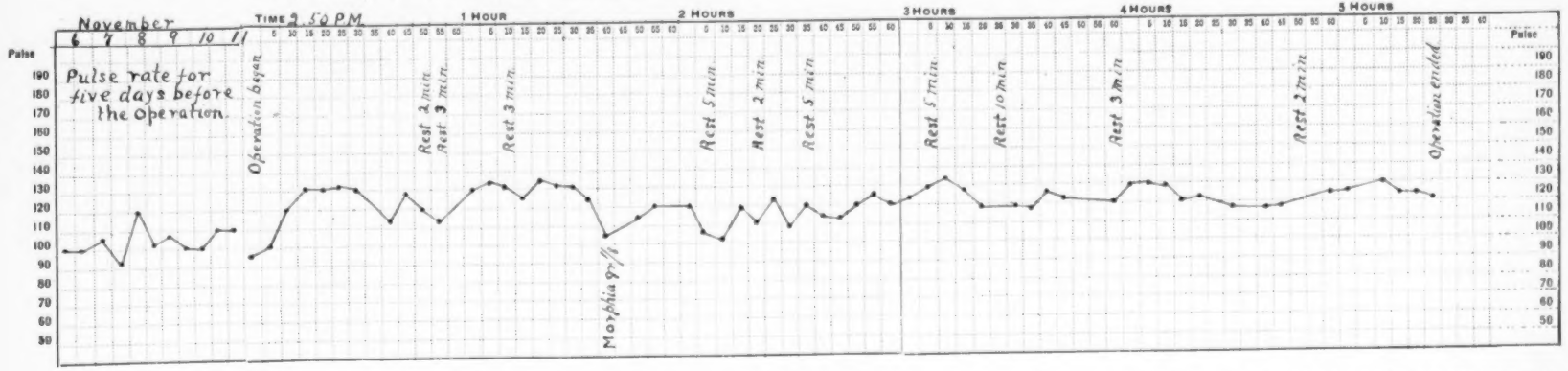
Resection of the Left Ureter and Its Reimplantation into the Bladder by the Inguinal Extraperitoneal Route, for Inefficiency of the Ureteral Orifice. November 11, 1903. Duration of the Operation, Five Hours and Twenty-five Minutes. Anæsthetic, Cocaine (Schleich's Solution), where necessary.

The ureter had been resected and reimplanted into the bladder, July 20, 1903 (under ether), for an inefficient ureteral orifice, and the operation had failed, for when the bladder was distended with fluid the fluid passed up into the pelvis of the kidney. On the other hand, the reimplantation of the right ureter (under local anæsthesia), *leaving* a *long piece* of the *ureter projecting* into the *bladder*, was *successful*, and fluid could not be forced from the bladder into the pelvis of the kidney.

An attempt was made to imitate the implantation of the right ureter. The scar tissue caused by the previous operation, July 20, 1903, rendered the operation very difficult. The operation was done as the one described September 8, 1903, except that the ureter was higher up in the pelvis, and on that account was more accessible; but the adhesions from the previous operation made its exposure more difficult. As in the previous operation, any steps in the operation which made traction on the parietal peritoneum caused pain. On the other hand, handling and cutting the ureter, as well as suturing the ureter into the bladder, did not seem to cause pain, while making an opening into the bladder seemed

Chart III.

Name.—Same patient as Charts I and II.
Date.—November 11, 1903.
Diagnosis.—Inefficient ureteral orifice (left), permitting a reflux of urine from the bladder into the kidney.
Operation.—Resection of the ureter and its implantation into the bladder by the inguinal extraperitoneal route.
Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, rest of the operation was done, for the most part, without an anæsthetic.



Traction on the parietal peritoneum was the main source of pain during the operation. Pinching, cutting, and suturing the ureter were apparently painless. The bladder (thickened and inflamed) was apparently very sensitive. Suturing the abdominal incision was the most painful part of the operation. Patient stood the operation remarkably well. The effect of the operation was that of hard work, the patient felt "tired out." Frequent "rests" caused a temporary fall in pulse-rate, giving rise to the irregular chart. Compare with Chart II. The general condition of the patient, aside from the fatigue, was the same after as before the operation. Result, the ureterovesical implantation healed, but the ureteral orifice was still inefficient. A similar operation on the right ureter was successful. Chart II.

to be painful. This operation differed from the one in the opposite side in that a small rubber male catheter about three millimetres in diameter was inserted into the ureter and out through the bladder and urethra and removed on the second day.

As in the previous operation, the patient felt tired out; the convalescence was rapid, as one recovering from the effect of several hours' hard work. On comparing the pulse Chart III with the chart of the operation on the other ureter (Chart II), it will be noticed that in Chart III the pulse varied much in rate during the operation. This variation in rate was apparently due to the frequent rests. While operating, the hard work on the part of the patient causes an increase in the pulse-rate, which is lowered by a two to eight minutes' rest, again to increase in rate when the operation begins. Frequent rests with a chance to change the position of the patient make the operation easier for all concerned. The ureterovesical implantation held, but the tip of the ureter projecting into the bladder sloughed off, leaving a ureteral orifice which was inefficient, as it had been after the previous operation.

An attempt was made to dilate the bladder slowly and carefully, and so possibly compress the ureteral orifice and render it efficient, but this failed. The vesicovaginal fistula was closed and the old trouble returned, but it was unilateral instead of bilateral, for the right ureteral orifice was able to prevent the reflux from the bladder. It was finally necessary to reopen the bladder and discharge the patient with a vesicovaginal fistula, which relieves all intravesical tension; and, under the circumstances, the patient will probably have to always have a vesicovaginal fistula.

Before beginning these operations, the patient had cystitis with bilateral renal infection, bilateral ureteritis, and stricture and inefficiency of both ureteral orifices. As a result of the operations, the cystitis disappeared and the stricture of the ureteral orifices was cured, and thus the condition of both kidneys was much improved; and one ureteral orifice is efficient, while the other, after two ureterovesical implantations, is unable to prevent a reflux of urine from the bladder if the bladder is closed. So it is necessary to have a vesicovaginal fistula in order to relieve intravesical tension, or else remove the left

kidney, which does not seem desirable, for fear of renal insufficiency of the opposite organ. A left nephrostomy could be done, but it would be difficult to maintain with a patulous ureter, and, besides, it has not many advantages over a vesico-vaginal fistula.

CASE II.—Mrs. A. M., aged forty-eight years. Gyn. Nos. 10,622, 10,713. (Referred to in a previous communication.[9])

Diagnosis.—Left ureterovaginal fistula, from necrosis of the ureter following hysterectomy for carcinoma cervicis uteri.

Operation.—Ureterovesical implantation, extraperitoneal, September 16, 1903.

Anæsthetic.—Cocaine (Schleich's Solution).

Contraindications to a General Anæsthetic.—Both ureters had been freed in the previous operation, leading to necrosis of the left ureter and the formation of a ureterovaginal fistula. The liability of renal insufficiency had to be considered, due to the interference with the function of the ureters. In addition, the patient dreaded a general anæsthetic.

HISTORY OF CASE.—*Family History* was negative; no history of cancer.

Personal History.—Always well. Married. Eight children.

Present Illness.—Patient was admitted to the hospital, July 21, 1903, with a diagnosis of carcinoma cervicis uteri with symptoms of bleeding for eighteen months.

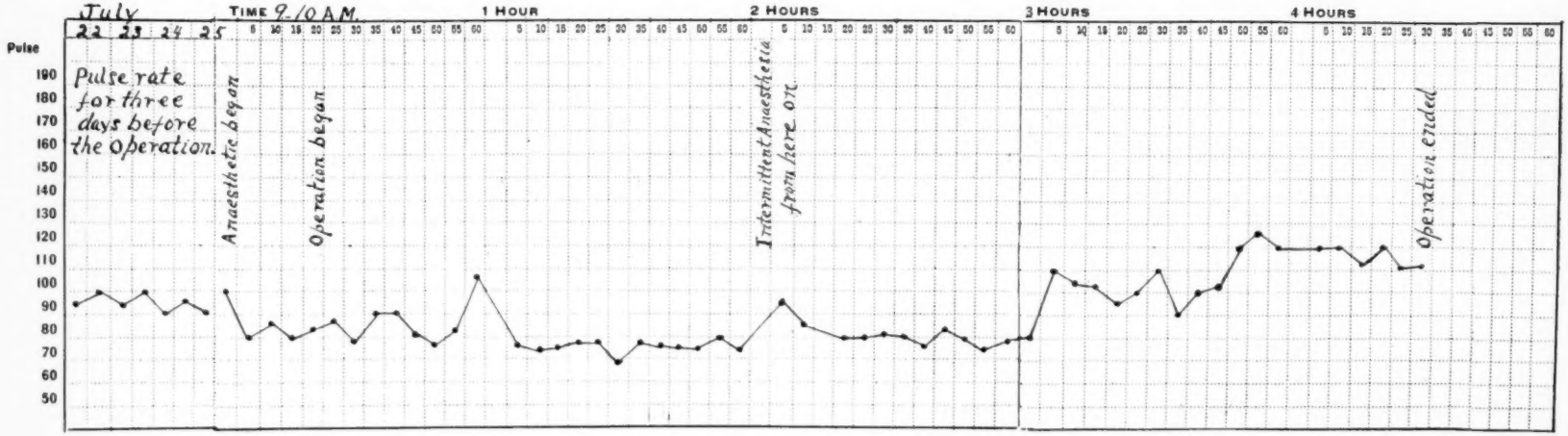
July 25, 1903, a more radical operation was done by the author. The ureters were dissected free, and an attempt was made to remove all the tissue from pelvic wall to pelvic wall. (Chart IV.) A lymph-node removed from the bifurcation of the left iliac artery proved to be cancerous. A left ureterovaginal fistula resulted, the escape of urine appearing on the thirteenth day.

The patient left the hospital August 27, 1903, with a ureterovaginal fistula, and returned October 10, 1903, desiring to have it closed.

DESCRIPTION OF OPERATION FOR THE CURE OF THE URETEROVAGINAL FISTULA.—Duration of operation, six hours and ten minutes. A skin incision was made under Schleich's Solution, parallel to Poupart's ligament, beginning about three centimetres mesial to the anterior superior iliac spine and extendng down to the inser

CHART IV.

Name.—Mrs. A. M. Age, 48. Gyn., No. 10,622.
Date.—July 25, 1903.
Diagnosis.—Carcinoma cervicis uteri.
Operation.—Abdominal hysterectomy, with removal of the pelvic lymphatics and freeing the ureters.
Anæsthetic.—Ether.
Amount of Anæsthetic.—About 500 grammes.



Anæsthetic well taken, the last hour the pulse was weaker and more rapid. Compare with Chart V. Convalescence, aside from the formation of a ureterovaginal fistula due to necrosis of the ureter, was uneventful. Discomfort, with nausea and vomiting, which may follow a long operation under a general anæsthetic. Result, recovery; ureterovaginal fistula closed September 15, 1903, under local anæsthesia. See Chart V.

Chart V.

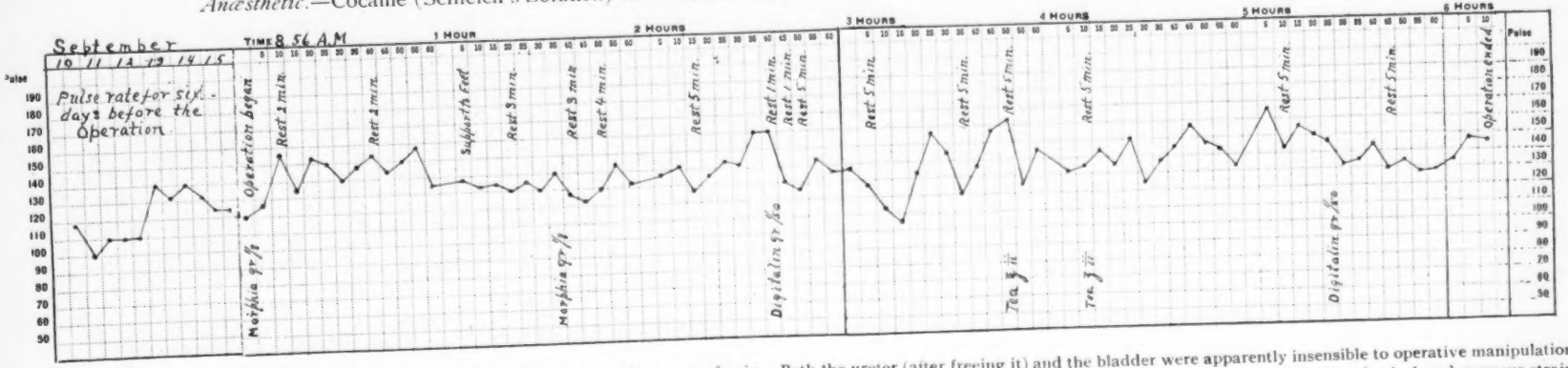
Name.—Mrs. A. M. Age, 48. Gyn., Nos. 10,622 and 10,713. (Same patient as Chart IV.)

Date.—September 16, 1903.

Diagnosis.—Ureterovaginal fistula, left, following ureteral necrosis from freeing the ureters in a more radical operation for carcinoma cervicis uteri. See Chart IV.

Operation.—Resection of the left ureter and its implantation into the bladder by the inguinal extraperitoneal route.

Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, and then where necessary.



As in previous operations, traction on the parietal peritoneum was the main source of pain. Both the ureter (after freeing it) and the bladder were apparently insensible to operative manipulation. The value of frequent "rests" causing a temporary fall in the pulse-rate was well brought out in this operation. The effect of the operation was that of hard work, *i.e.*, physical and nervous strain, causing a rapid pulse (temporary) and fatigue, as that of a patient in a dentist's chair. Compare with Chart IV. Result, patient cured, ureteral orifice apparently normal, unable to catheterize it, patient felt perfectly well.

tion of the rectus muscle. A similar incision was used through the muscles of the abdominal wall down to the peritoneum. The peritoneum was dissected free from the abdominal wall, and this was found to be very difficult, because it had been freed at the previous operation, the Poten incision having been used. The deep epigastric vessels were cocainized, clamped, cut, and ligated. The separation of peritoneum was carried on down to the external iliac vessels, and the bladder was separated from the sides of the pelvis. The separation of the bladder from the walls of the pelvis did not cause any pain; on the other hand, freeing the peritoneum was painful, requiring very slow and careful work. At the previous operation the round ligament and ovarian vessels had been sutured to the top of the vagina, and, in order to reach the ureter, it was necessary to cut through these structures. The ureter was found to be firmly embedded in adhesions, and with great difficulty it was dissected free down to a point about two centimetres above the bladder, where it became much smaller, being about 1.5 centimetres in diameter above this place, and filled with clear urine (cultures taken from this urine showed it to be sterile). The ureter was now cut off just above its strictured portion. Clamping and cutting the ureter (not cocainized) did not cause any pain. The ureter was dissected free for its entire pelvic portion, so that it could be brought down to meet the bladder. After the distended ureter had emptied itself, much to my surprise, it resumed its normal appearance and size. A straight aneurism needle was now introduced into the urethra and the bladder wall was pushed out in the direction of the ureter and incised. This step in the operation did not cause pain. A catgut suture was passed through the end of the ureter and tied to the end of the aneurism needle. On withdrawing the latter from the bladder through the urethra, the ureter was drawn into the bladder incision. The edges of the incision in the bladder were sutured to the ureteral wall by means of fine silk, using five or six sutures, which included the muscular coats of the ureter and bladder. The bladder wall at the site of the implantation was sutured to the side of the pelvis in order to fix the bladder at this place and relieve the tension of the implantation. Additional sutures were also taken, drawing the bladder up and fastening it to the psoas muscle. In spite of these sutures, the ureter was sutured into the bladder under considerable tension.

Gauze drains were placed down to the site of the implantation, and an additional pack was placed on top of the bladder so as to hold the bladder down on the ureter.

The observations in regard to the sensation of pain seemed to be very trustworthy in this case. The abdominal incision down to the peritoneum was accomplished under cocaine (Schleich's Solution) infiltration, with very little pain. The only feature in the operation which seemed to cause pain was traction on the parietal peritoneum. All operative steps on the ureter, such as clamping, cutting, and suturing, were without pain; on the other hand, traction on the ureter and freeing it from its peritoneal attachments (*i.e.*, traction on the parietal peritoneum) caused pain. All operative manipulations of the bladder, such as freeing it from the side of the pelvis, incising it and suturing it to the ureter and to the side of the pelvis at the site of the implantation, were apparently painless. In order to expose the field of operation, it was necessary to hold aside the freed peritoneum. This caused pain unless done very carefully, and any change in the exposure had to be done slowly and gradually in order to avoid unnecessary pain. The effect of the operation was that of hard work, manifesting itself in the fatigue after the operation and the rapid pulse during it. Had the operation been done without any rest, then undoubtedly there would have been maintained a high pulse-rate, as during prolonged exertion, somewhat as shown in Chart II; but with the frequent rests (the shorter ones not being charted) the rapid pulse manifested itself only when the operation was in progress and would fall as soon as the active operation ceased. (Chart V.) Morphia was tried, but did not seem to have much effect. Digitalin was also given to see if it would affect the pulse-rate, but it is questionable just what effect it had, for the apparent effect might have been due to the rest taken at that time. The patient felt as well after the operation as before, except for the fatigue. Apparently the patient and the operator were both fatigued as the result of the operation. What effect does pain have on the pulse? Lennander [10] speaks of the injurious effects of pain on a weak heart. A dentist thinks little of inflicting pain upon a patient for hours; and it seems to me that his operations are apparently as severe and frequently more severe than the one I have just described. The patient exercises her muscles in the following ways: The position, no matter how

comfortable, becomes tiresome (the patient frequently changes her position); to exercise self-control is hard work; besides, she does actual muscular work in grasping something with her hands or bracing her feet against some support. These procedures help the patient.

After the operation the patient was asked how she felt, and replied that, aside from feeling tired, she felt well and was hungry. She asked for bread and butter and raw tomatoes for supper, which she ate with great relish and without any apparent evil effects.

Result.—The ureterovaginal fistula was cured. There was no leakage of urine until the eighth day, when only about half the amount of urine was obtained from the bladder as on previous days, and there was an escape of a large quantity from the inguinal incision. This ceased in a few days, and the patient left the hospital cured. The bladder was examined before the patient left the hospital, and, while the end of the ureter could be seen protruding into the bladder, I was unable to catheterize it, and think that the ureter may have sloughed above the bladder, leading to a secondary fistula, which healed, but possibly with occlusion of the ureter, for the amount of urine obtained from the bladder each day did not reach the daily amount excreted during the first week after the operation.

CASE III.—Miss F. P., aged nineteen years. Gyn. No. 10,701½.

Diagnosis.—Ureteral calculus, right (situated just above the bladder).

Operation.—Ureterotomy, with removal of calculus through the inguinal extraperitoneal route, December 2, 1903.

Anæsthetic.—Cocaine (Schleich's Solution).

Contraindications to a General Anæsthetic.—Patient had obstructive anuria twice, and each time was relieved by nephrostomy; in addition, a vesicovaginal and suprapubic fistula had been formed to relieve a very severe cystitis. She had taken a general anæsthetic badly, and had been very ill afterwards, and on account of the above she desired to have this operation undertaken with a local anæsthetic.

HISTORY OF THE CASE.—*Family History* was negative; no history of tuberculosis.

Personal History.—Negative, until present illness.

Present Illness.—Six years' duration, with symptoms of a very severe cystitis,—frequency and painful micturition, urine at times bloody, incontinence of urine at night. No definite renal symptoms.

Patient admitted to this hospital, January 22, 1903. A diagnosis of cystitis was made. A vesicovaginal fistula was made February 4, 1903, by Dr. Kelly, and a suprapubic vesical fistula, March 4, 1903, by Dr. Schenck. Treatment consisted in bladder irrigations with a retention catheter, and the patient was placed in a tub of water. Patient had several attacks of fever with severe headache, without any definite localizing symptoms.

May 4, 1903. Anuria of six hours' duration. Localizing symptoms were rather indefinite, but on deep palpation there seemed to be a slight amount of tenderness under the right costal margin. A lumbar nephrotomy was done by the author, on the right side, the kidney was found to be enlarged, a large quantity of foul-smelling, purulent urine, with a small stone, escaped on opening the pelvis of the kidney. The operation was done under ether as a general anæsthetic.

July 3, 1903. Following the previous operation, the patient frequently had fever, with headache, nausea, and vomiting. During twenty-four hours previous to present operation there had been some slight pain and tenderness in the region of the left kidney, associated with the absence of urine in the bladder for eighteen hours. Nephrotomy wound on the right side was still discharging. Under ether anæsthesia, a nephrotomy was done on the left side, permitting an escape of a large quantity of purulent urine.

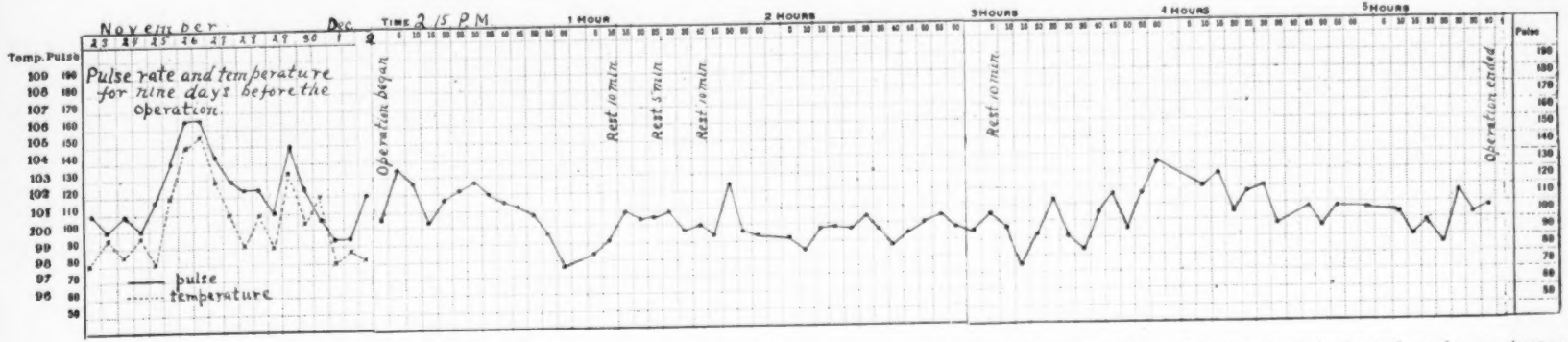
During the next month the lumbar incision in the right side would close, and associated with it there would be fever, but very few localizing symptoms. A ureteral *catheter* was *coated* with *wax* for its *entire length*, and on catheterizing the right ureter it was found to be scratched for a distance corresponding to a point just above the bladder. An X-ray was taken, and the shadow of a stone about as large as an orange-seed was seen just above the entrance of the ureter into the bladder.

DESCRIPTION OF OPERATION FOR THE REMOVAL OF THE URETERAL CALCULUS, DECEMBER 2, 1903.

Duration of operation was five hours and forty minutes. A skin incision was made under Schleich's Solution, beginning just

CHART VI.

Name.—Miss F. P. Age, 19. Gyn., No. 10,701½.
Date.—December 2, 1903.
Diagnosis.—Ureteral calculus, right.
Operation.—Ureterotomy, with removal of calculus by the inguinal extraperitoneal route.
Anæsthetic.—Cocaine (Schleich's Solution), where necessary.



Traction on the parietal peritoneum was the main source of pain. Pinching, cutting, and suturing the *freed* ureter were apparently painless. Frequent rests helped greatly, and many short ones were resorted to which were not charted. The pulse-rate increases during the operation (work) and falls during "rest." The effect of the operation was that of hard work, *i.e.*, physical and nervous strain, as that of a patient in a dentist's chair. Result, operation was successful; patient left the hospital apparently cured.

above and about three centimetres inside of the anterior superior iliac spine and carried down parallel to Poupart's ligament to the insertion of the rectus muscle. The muscles were cut through down to the peritoneum, taking care to infiltrate the blood-vessels with cocaine before clamping and cutting them. The peritoneum was pushed back from the abdominal wall. This caused pain, but by going slowly the patient was able to stand it. The round ligament and deep epigastric vessels were cocainized, clamped, cut and ligated. Both structures were apparently sensitive to pain. The freeing of the peritoneum from the sides of the pelvis also caused pain, but was accomplished by going slowly and infiltrating the subperitoneal tissue with Schleich's Solution. This latter procedure seemed to help but very little.

The ureter was exposed at the pelvic brim. *Traction on the ureter caused pain;* on the other hand, pinching the ureter with *mouse-tooth forceps did not cause pain.* The ureter was incised without causing pain. A wax-coated catheter was passed up into the kidney. No evidence of scratch-marks. The catheter was next passed down towards the bladder, and on removing the catheter it was found to be scratched to a point within six centimetres of the opening in the ureter. The ureter was now exposed down to a point within 2.5 centimetres of the bladder. A second incision was now made into the ureter at this point without causing any pain, and the stone easily felt with a probe about two centimetres below the opening in the ureter. Attempts to dislodge the stone were unsuccessful, and it was found necessary to incise the ureter over the stone, which seemed to cause a slight amount of pain, and remove it through this incision. The incisions in the ureter were closed with fine silk without causing the patient any pain. The bladder was partially freed, with but very little pain. The uterine artery was clamped, cut, and ligated without causing pain. The superior vesical artery was also cut, and some difficulty experienced in controlling it, thus emphasizing one of the disadvantages of operating under a local anæsthetic. The field of the operation was freely drained with gauze, and the skin and muscle incision partially closed with interrupted sutures of silkworm gut. The closure of the skin incision was the most painful part of the operation.

As in the previous operations under a local anæsthetic, the main source of pain came from traction on the parietal peritoneum,

either in freeing it, maintaining an exposure by drawing it aside, or dissecting the ureter from it. The patient stood the operation very well, and the effect of the operation was that of fatigue. The patient felt tired out. The patient stated that she preferred an operation under cocaine to one under a general anæsthetic.

Result.—Patient recovered.

The vesicovaginal fistula was successfully closed, March 5, 1904, under ether. The patient desired to have it done under cocaine, but the exposure was very difficult, and the general anæsthetic permitted greater relaxation, and hence a better exposure; and there were not the same contraindications as at the previous operation, for the removal of the calculus permitted the kidney to recuperate, and the general condition of the patient was much better, and, besides, the operation was of short duration. May 14, 1904, the suprapubic vesical fistula was also successfully closed under ether. A previous attempt to close it under cocaine was unsatisfactory and failed. This attempt was much more painful than any part of the operation when the calculus was removed, the scar tissue about the fistula being very sensitive and difficult to excise. Patient discharged, June 10, 1904, apparently well. Capacity of the bladder was 120 cubic centimetres. She was advised to return in six weeks in order to have her bladder dilated.

In studying these four operations on the lower end of the ureter, by the extraperitoneal route, under a local anæsthetic, one not only has an opportunity to learn something about the advisability of the use of a local anæsthetic in these cases and the advantages of the extraperitoneal route, but, what seems to me to be of the greatest importance, a knowledge is obtained of the factors causing pain in these operations. A knowledge of the distribution of the sensation of pain in any part of the body is not only of assistance in choosing an anæsthetic for operations in that portion of the body, but may eventually help us in the interpretation of the symptoms arising from diseased conditions of these parts.

The Causation of Pain in these Operations.—In all four operations, closing the skin incision was the most painful step in the operation, and anything causing traction on the parietal peritoneum, as has been emphasized by Lennander,[10]

was painful, as, freeing the peritoneum from the abdominal walls and sides of the pelvis, traction on the ureter, and freeing it from its peritoneal attachments. In order to expose the field of operation, it is necessary to maintain pressure on the freed peritoneum, and this is painful unless it is done carefully, and any change in position must be accomplished slowly.

Apparently the ureter (freed from its peritoneal attachments) may be pinched, incised, and sutured without causing pain. Is there any sensation of pain in the ureter, or is any pain which may be referred to it due to the stretching of nerves in the parietal peritoneum covering the pelvic portion of the ureter? The passage of a ureteral calculus is supposed to cause ureteral pain. One may inject the ureter with fluid through a ureteral catheter and pain will be felt in the region of the kidney, this being a very efficient means of locating obscure pain in the side, as has been described by Kelly.[11] We realize, too, that the palpation of a diseased ureter may be painful. The histories of cases of intentional or accidental ligation of the ureters help us but very little. We have discovered that a ureter has been accidentally occluded by ligatures in three gynæcological cases in this hospital which have come to autopsy, and yet there were no symptoms referable to the injury, or such as might have been present were obscured by other symptoms resulting from the operation. Two of these three cases have been reported.[12] Noble [13] refers to a similar experience, and the cases reported by Veit,[14] Bastianelli,[15] and Phaenemenow,[16] where a ureter was intentionally ligated, the patient recovered without any symptoms referable to the injury; while in a case reported by Futh [17] and also one by Landau,[18] the symptoms were those of a sense of fulness or dull pain in the region of the kidney. I saw, in consultation, a patient in whom both ureters had been cut off and ligated for thirty-six hours, and yet anuria was the *only* symptom present, and both ureters, which were greatly distended, were released and reimplanted in the bladder, and the patient recovered. Bailey [6] has reported an instance of the ligation of both ureters and their release after forty-eight hours,

with recovery, and anuria was the only symptom. In Purcell's [8] case of ligation of both ureters, with subsequent release at the end of fifty-eight hours and recovery, there were not any localizing symptoms until the third day. Markoe and Wood [4] report a case of accidental ligation of both ureters of twenty-four hours' duration, and yet there were no symptoms distinctly referable to the injury. In the repair of a vesicovaginal fistula in this hospital a ureter was apparently included in a ligature. Pain in course of ureter for four days, with chills and fever, which disappeared on releasing some of the suture. And in another instance (Gyn. No. 11,164) where a vesicovaginal fistula was made, in order to relieve a cystitis, and the mucosa of the bladder was sutured to that of the vagina, apparently one of the sutures occluded or compressed the ureteral orifice, for there was pain and tenderness in the region of the left kidney, which was relieved by releasing the suture. In these last two cases one could not tell whether one was dealing with partial or complete occlusion of the ureter. It is possible that the ureter may be completely occluded and the patient's convalescence be uninterrupted and entirely without any symptoms referable to the injury. Stoeckel [19] has referred to the above, and states that in the absence of infection there are often apparently no definite symptoms, or such as there are may be easily obscured by the symptoms following such an operation; and the other kidney, if sound, can readily adjust itself to the additional work, and so prevent the threatened uræmia.

Effect of the Operations on the Patient.—By studying the pulse-rate during the operation, it may be seen that it increases in rate during the active operative manipulations and drops as soon as these stop. If frequent rests are taken, the pulse-curve becomes very irregular (Charts III, V, and VI), while, if the rests are less frequent, a higher and more even pulse-rate is maintained throughout the operation (Chart II). Several factors influence this pulse-rate, as, hard work, for it is equivalent to hard muscular exercise (the patients like to brace their feet against something or grasp something firmly with their hands); the excitement and mental

strain must also influence the rate, and possibly the pain also increases the pulse-rate. The result of the above is that the patient becomes fatigued, and the only apparent effect of these operations, lasting from four hours and thirty minutes to six hours and ten minutes, was that of fatigue, just as one might feel after spending several hours in the dentist's chair. The patients stood the operations very well, and all stated that they preferred local to a general anæsthetic.

UPON WHAT DOES THE SUCCESS OF THESE OPERATIONS DEPEND?—1. In knowing what does and what does not hurt, and thus avoiding all unnecessary pain. Severe pain will unfit the patient for any further progress of the operation, unless a general anæsthetic is used.

2. In going very gradually and carefully and avoiding any sudden moves, which is especially true in exposing the field of operation.

3. In stopping frequently in order to let the patient rest and change her position.

4. In choosing suitable patients, and letting them know just what to expect, so that they may help you in the determination of what hurts, in order that unnecessary pain may be avoided.

5. In the presence of a so-called " moral anæsthetist," who will encourage the patient and divert her attention when necessary.

6. The use of morphia before and during the operation probably helps in some cases. A towel over the eyes of the patient, so she cannot see what is going on, and cotton in the ears to muffle any sounds from the use of instruments also helps.

I was tempted to try a local anæsthetic in the first case on account of the contraindications of a general anæsthetic, for it seemed that an operation would have to be done under a local anæsthetic or further operative attempts abandoned. The satisfactory use of local anæsthesia in the radical cure of certain cases of hernia, as reported by Cushing,[20] seemed to me to offer inducements for its use in the surgery of the lower ends of the

ureters by the inguinal extraperitoneal route. The satisfactory result of the first operation on the first case induced me to try it in the next three operations, and all three cases having had operations under both a local and a general anæsthetic, while admitting that the operation under local anæsthesia at times was painful and very fatiguing, prefer local to general anæsthesia.

The solution of cocaine used was:

Cocainæ hydrochloratis	0.1	gramme
Morphinæ hydrochloratis	0.02	gramme
Sodii chloridi	0.2	gramme
Aquæ destillata ad	100	cubic centimetres

About thirty cubic centimetres of this solution are placed in a small flask and sterilized with the dressings in a steam sterilizer.

THE CHOICE OF AN INCISION, AND THE INGUINAL EXTRAPERITONEAL ROUTE AS AN AVENUE FOR EXPOSING THE LOWER END OF THE URETER.—By the inguinal extraperitoneal route, one refers to an abdominal incision down to the peritoneum, and then the peritoneum is pushed away from the abdominal and pelvic walls, and thus the field of operation, in which the lower end of the ureter lies, is exposed. Various incisions have been employed for this route.

Twynam,[21] in 1890, employed this route for the successful removal of a ureteral calculus, situated two inches above the bladder, in a boy eight years old. His incision was similar to one used for the ligation of the common iliac artery. Since Twynam's case, this route has been used by others for the removal of calculi in the lower end of the ureter. See table of cases compiled by Schenck.[22]

Rouffart,[23] in 1895, suggested making an incision along the outer border of the rectus, dissecting the peritoneum from the pelvic wall, and thus exposing the lower end of the ureter, for the resection of the ureter and its implantation in the bladder for the cure of ureterovaginal fistulæ.

In 1898, Kelly[24] employed the extraperitoneal route for

the cure of an ureterovaginal fistula. The incision was fifteen centimetres long, and began two centimetres inside of the right anterior superior iliac spine and ended near the pubic spine. Somewhat similar incisions were employed in operations in Cases I, II, and III.

The following year Israel[25] reported a similar but more extensive incision for the successful resection of an ureteral stricture and implantation of the ureter into the bladder.

Mackenrodt,[26] in 1899, reported a ureterovesical implantation by the extraperitoneal route, using an incision along the outer border of the rectus muscle, as suggested by Rouffart.

Crossed, curved abdominal incisions have been made by Wertheim[27] and others.

Smith,[28] in 1901, used an incision in the median line for the same purpose.

One sees that almost as many incisions have been used for this route as there are possibilities, and it seems almost useless to add others. Nevertheless, it seems to me that an intramuscular incision, in which the muscle fibres are not cut, offers advantages over the above, in that there is less injury, and also less danger of a postoperative hernia; for I believe in the extensive draining of the field of operation. One incision which I have found very useful for exposing the lower end of the ureter is a so-called " gridiron incision," made similar to the well-known McBurney incision, down to the peritoneum, except that it should be made a little lower down. Such an incision was used in Case I. Another serviceable incision is a longitudinal one through the rectus muscle. I have tried all the various incisions above referred to except the transverse abdominal incisions, and I think that the two intramuscular incisions referred to, in which the muscle fibres are separated but not cut, are to be preferred to the others, and by either of these incisions the ureter can usually be exposed from the pelvic brim to the bladder, and if more room is desired, the muscles may be cut at any time.

CONCLUSIONS.

I. In favor of the use of a general anæsthetic it may be said:

1. The patient is unconscious of everything associated with the operation, including the pain.

2. There is complete relaxation, thus permitting a better exposure of the field of operation, which is especially desirable in operations in the pelvis.

3. The operation takes a much shorter time than a similar operation under a local anæsthetic.

4. The operation is easier, and all the above render it possible usually to do better work than under a local anæsthetic.

II. There are many disadvantages in the use of a general anæsthetic.

1. In certain cases it is contraindicated.

2. A small percentage of the cases die on the table from the anæsthetic alone.

3. In all cases it lowers the general resistance of the individual, thus predisposing the patient to many postoperative complications.

4. The taking of the anæsthetic is usually very unpleasant, and the recovery from it still more so.

III. If certain operations do not cause any pain and very little discomfort, why should patients be subjected to the dangers and discomforts of a general anæsthetic in these operations? And if certain steps in a long operation, where a general anæsthetic is contraindicated, are painless, why not use a temporary general anæsthetic, such as nitrous oxide, or a local anæsthetic, as cocaine, *only* for that part of the operation which causes pain?

IV. A knowledge of the distribution of the sensation of pain in the various parts of the body is not only interesting from a physiological stand-point, but especially valuable in the diagnosis of diseased conditions, and the *intelligent* use of a local or temporary anæsthetic in those cases in which a general anæsthetic is contraindicated.

V. Pathological conditions of the lower ends of the ure-

ters usually impair the function of the ureters, either interfering with the passage of urine from the kidneys to the bladder or permitting a reflux of urine from the bladder into the kidneys. In either instance the result is interference with the function of the kidneys and a condition of actual or unstable renal sufficiency results, thus lowering the general resistance of the individual, and in addition predisposing the kidneys to infection. The result of the above is that such individuals may not be well suited to a long operation under a general anæsthetic, which may be necessary to cure the local condition.

VI. In four operations on the lower ends of the ureters by the inguinal extraperitoneal route under local anæsthesia, lasting from four hours and thirty minutes to six hours and ten minutes, the only apparent effect of the operation, aside from postural discomfort and at times some pain (endurable), was that of fatigue, as of a similar length of time spent in a dentist's chair.

VII. The success of these operations is dependent on a knowledge of what does and what does not hurt, and on proceeding slowly and carefully, remembering that *anything causing traction* on the *parietal peritoneum* is *painful.* Pinching, cutting, and suturing the ureter in these cases apparently did not cause any pain, and similar treatment of the bladder in one case was painless but painful in another (bladder much thickened; chronic cystitis). Closing the abdominal incision was the most painful step in all four operations.

VIII. The extraperitoneal route is a very satisfactory way of reaching the lower ends of the ureters, and would be less painful than the intraperitoneal, and has many advantages over the other. The danger from infection is less; by draining freely, the retroperitoneal tissue is well protected and the intestines are kept back by the peritoneum, thus giving one a good exposure; and there must be less shock associated with the extraperitoneal than with the intraperitoneal operation.

IX. Many incisions through the abdominal wall have been used for the extraperitoneal route, and the intramuscular incisions can be recommended, as doing little harm, rendering the

liability of postoperative hernia small, and affording a good exposure. *Two incisions are very good; first, a "gridiron incision" lateral to the rectus similar to the well-known McBurney, only a little lower; and, secondly, a longitudinal incision through the rectus muscle.* Through either incision the ureter can usually be exposed from the pelvic brim to the bladder, and if more room is desired, the muscles may be cut at any time.

REFERENCES.

[1] Sampson. The Pelvic Ureteral Sheath: Its Relation to the Extension of Carcinoma Cervicis Uteri. The Journal of the American Medical Association, 1904, xliii, 707–712.

[2] Zweifel. Festschrift zur Einweihung der neuen Universitats Frauenklinik zu Leipzig, Berlin, 1892. Quoted by Hochstetter, Arch. f. Gyn., 1894, xlv, 109.

[3] Purcell. British Gynæcological Journal, 1898, liv, 174.

[4] Markoe and Wood. Uretero-ureteral Anastomosis for Traumatism. ANNALS OF SURGERY, 1899, xxix, 694–697.

[5] Neumann. Drei Fälle von operativen Ureterläsionen. Hygiea, Band lix, 11, 598. Ref. Cent. f. Gyn., 1899, xxiii, 1184.

[6] Bailey. Vaginal Hysterectomy for Adenocarcinoma of the Cervix Uteri. The Clinique, 1903, xxiv, 41–46.

[7] Bevan. The Surgical Treatment of Anuria. ANNALS OF SURGERY, 1903, xxxvii, 575–591.

[8] Sampson. Ascending Renal Infection: with Special Reference to the Reflux of Urine from the Bladder into the Ureters as an Etiological Factor in Its Causation and Maintenance. Johns Hopkins Hospital Bulletin, 1903, xiv, 334–352.

[9] Sampson. Complications arising from Freeing the Ureters in the More Radical Operations for Carcinoma Cervicis Uteri, with Special Reference to Postoperative Ureteral Necrosis. Johns Hopkins Hospital Bulletin, 1904, xv, 123–134.

[10] Lennander. Observations on the Sensibility of the Abdominal Cavity. Translated by Barker, 1903. John Bale Sons and Daniel & Sons, London.

[11] Kelly. The Use of the Renal Catheter in Determining the Seat of Obscure Pain in the Side. American Journal of Obstetrics, 1899, xl, 328–334.

[12] Sampson. Ligation and Clamping the Ureter as Complications of Surgical Operations. American Medicine, 1902, iv, 693–700.

[13] Noble. Clinical Report upon Ureteral Surgery. American Medicine, 1902, iv, 503.

[14] Veit. Ueber Heilung einer Ureterenverletzung. Zeit. f. Geb. und Gyn., 1895, xxxi, H. 2, 454.

[15] Bastianelli. Ann. di Obstet. e. Gin., Milano, 1896, xviii, 134.

[16] Phaenemenow. Ein interessanter Fall von Ureterverletzung beim Bauchschnitte. St. Petersburger Geb.-Gyn. Gesellschaft, 1900, February 17–29. Ref. Cent. f. Gyn., 1901, xxv, 22.

[17] Futh. Beiträg zur Behandlung Ureterenberletzungen. Cent. f. Gyn., 1898, xxii, 729–737.

[18] Landau. Nierenausschaltung durch Harn leiter unterbindung. Deutsche med. Wochenschrift, 1900, xxvi, 749–750.

[19] Stoeckel. Ureterfisteln und Ureterverletzungen. Breitkopf and Härtel, Leipzig, 1900, S. 27–28.

[20] Cushing. The Employment of Local Anæsthesia in the Radical Cure of Certain Cases of Hernia, etc. ANNALS OF SURGERY, 1900, xxxi, 1–34.

[21] Twynam. A Case of Calculus impacted in the Ureter; Removal. Transactions of the Clinical Society of London, 1890, xxiii, 93–97.

[22] Schenck. The Symptoms, Diagnosis, and Surgical Treatment of Ureteral Calculus. The Johns Hopkins Hospital Reports, Vol. x, Nos. 6–7, 8–9, 477–513.

[23] Rouffart. Ann. des Mal. Gen.-Urin., 1895, xiii, 172.

[24] Kelly. Ureteral Anastomosis. American Gynæcological and Obstetrical Journal, 1898, xii, 725–741.

[25] Israel. Beiträg zur Ureterchirurgie. Freie Vereiningung der Chirurgen. Berlin, February 6, 1899. Ref. Berliner klin. Wochenschrift, 1899, xxxvi, 201.

[26] Mackenrodt. Die Operation der Ureterfisteln und Ureter verletzungen. Cent. f. Gyn., 1899, xxiii, 318–323.

[27] Wertheim. Beiträge zur Ureteren Chirurgie. Monat. Geb. und Gyn., 1900, xi, 438–452.

[28] Smith. A Case of Transplantation of the Ureter for the Cure of Ureterovaginal Fistula. Philadelphia Medical Journal, 1901, viii, 655–657.

PRIMARY URETHRAL CALCULUS.[1]

WITH REPORT OF A CASE.

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On account of the rarity and size of the calculus found in the urethra and the absence of symptoms, the following case is thought worthy of reporting.

Abstract from Clinical History.—The patient, male, aged fifty years, works in dyes used in staining tanned hides; no previous illness except gonorrhœa twenty years ago; denies syphilis or its symptoms; uses alcoholic beverages freely. When admitted to the Cook County Hospital, service of Dr. Sherwood, April 8, 1904, he had a marked cirrhosis of the liver, and cellulitis of the leg following a slight injury. Two specimens of urine were examined and found clear, amber colored, distinctly acid, no sediment; the first having no albumen and the second only a trace. Blood count showed leucocytosis of 12,000. After running a septic course, death occurred April 19, 1904.

Anatomic Diagnosis (*Dr. Stober*).—Suppurative cellulitis of the leg; syphilitic cirrhosis of the liver; chronic nephritis; chronic hyperplastic splenitis; varicose veins of the œsophagus and abdomen; ascites; passive hyperæmia of the viscera; sclerosis of the aorta; obliterative fibrous pleuritis of the right side; hyperplasia of the tracheobronchial lymph glands with calcification; multiple calculi in the urethra.

The serious septic condition of the patient and the total absence of symptoms pointing to the involvement of the genito-urinary tract caused the calculus to be overlooked during the life of the patient. The calculus weighs 23.62 grammes, is some-

[1] Read before the Chicago Pathological Society, October 10, 1904.

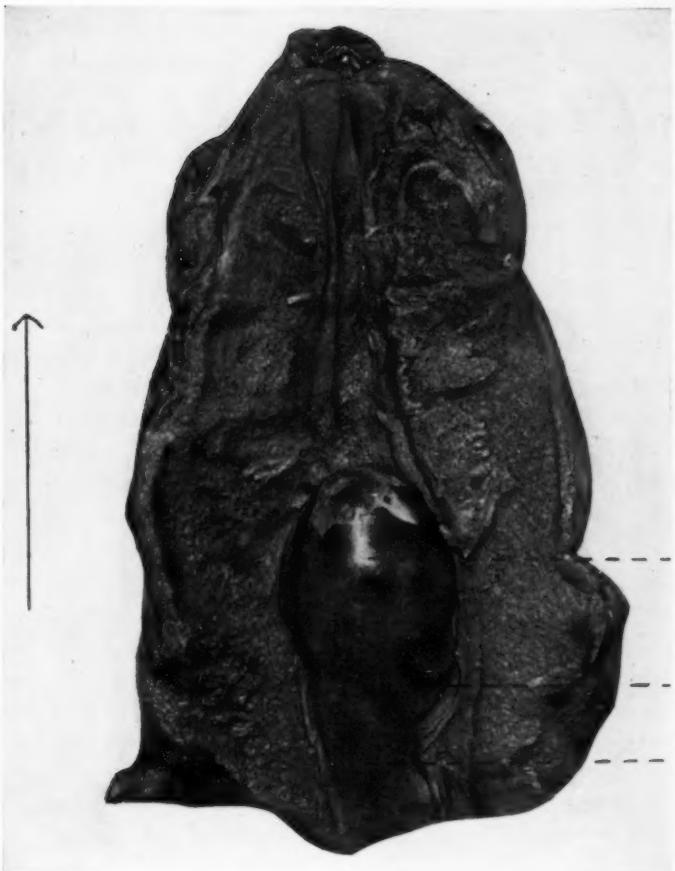

FIG. 1.—Penis and urethra split ventrally. Arrow at left of figure shows direction of urinary current. *a*, larger mass of the calculus; *b*, posterior protrusion joining larger mass by narrow neck, *c*.

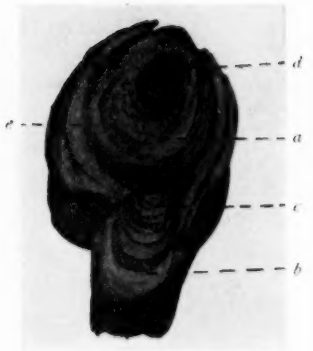

FIG. 2.—Longitudinal section of the calculus showing the egg-shaped nucleus (*d*) with the empty cavity at its anterior end, and also showing concentric arrangement of the layers in both the main body (*a*) and the posterior protrusion (*b*); *e* shows portion lodged in the diverticulum on the dorsal side of the penis; and *c*, the narrow constriction at the posterior brim of the diverticulum.

what irregular in contour, and appears to be made up of two ovoid constituents fused together as they lay in contact by the deposition of urinary salts. The dimensions of the larger mass ((*a*) Fig. 1) are, length three, width 2.4, thickness 3.3 centimetres. To this is added posteriorly another part ((*b*) Fig. 1), joining the former by a slightly narrowed neck ((*c*) Fig. 1). This is ovoid in shape and measures 1.6 centimetres in length and 1.2 centimetres at its greatest diameter. The greater part of the surface is smooth and of a yellowish brown color, notably the upper surface, which in reality forms the floor of the urethra, while the portion measuring two by three centimetres, lying in a distinct diverticulum, is gently faceted, owing to the presence of 130 or more small millet-seed sized, grayish concretions which stud the lining of the sac, and is of a dirty gray color.

On section longitudinally, the calculus is found to be composed of easily discernible concentric layers, either complete or crescentric, deposited about a prominent nucleus ((*b*) Fig. 2), which is about the size of a sparrow's egg and bears marked resemblance to the same in shape, lying with its small end in the direction of the urinary current, as indicated by the arrow in Fig. 1. The nucleus has in itself a pea-sized cavity (Fig. 2) containing a small amount of phosphatic débris. It may be readily inferred that this cavity was originally a mass of organic matter consisting of blood, pus, or some other inflammatory product, resulting from the patient's early gonorrhœa or some trauma; forming the nucleus for the future deposit, and as the inorganic salts were deposited as a thin shell, the organic matter was broken down and removed by a process of osmosis leaving an empty cavity. Posteriorly this cavity is bounded by three well-marked crescentric layers of considerable density, each crescent increasing in extent towards the periphery. About these and forming the only wall at the anterior end of the cavity is a layer approximately only one millimetre thick, constituting, as it were, a shell for the egg-shaped nucleus. This egg-shaped mass lies at the anterior end of the whole calculus, and has about itself a grayish loose layer, thickest posteriorly. Upon this follow a number of yellowish brown crescentric layers, also increasing in extent outward and of considerable density. These crescents are small where the calculus reaches the posterior brim of the diverticulum and make up the bulk of this posterior protrusion ((*b*)

Fig. 2). Surrounding the mass, except at its most anterior point, is a grayish zone, soft and granular; and this is covered by the outermost layer, complete, one millimetre thick, hard, brittle, and only loosely cemented to the preceding layer.

As to its relation to the urethra, the calculus occurred in the pars pendula of the penis; its foremost point being 5.4 centimetres posterior to the meatus urinarius externus, while the rear portion is ten centimetres distant from the same point. The anterior inferior portion ((*e*) Fig. 2) is lodged in a diverticulum lying in the median dorsal surface of the urethra. This pocket, or diverticulum, closely fits about its contents, but evidently has permitted of some motion of the same, as deposition has occurred uniformly on this included surface as well as on the free surface of the calculus. The wall of this sac is made up of all the normal coats of the urethra, including the mucosa. It is slightly thickened with some preponderance of fibrous tissue, especially at the anterior portion. The remainder of this calculus encroaches upon the lumen of the urethra, converting the same into a crescentric slit for the extent of itself, but evidently not interfering with the passage of urine.

After a thorough investigation of the literature, Professor Englisch, of Vienna, has collected 405 cases of urethral calculi, and classifies them as to age and localization as shown in Table I, and composition, as shown in Table II.

In the accompanying Table I, given by Englisch, it is evident that the number of cases of urethral calculi increases decidedly as the upper portions of the urethral tract are approached,—there being 41 cases in the fossa navicularis; 53 in the pars pendula; 50 in the pars scrotalis; 68 in the pars bulbosa; and 149 in the pars membranica. This division into these respective parts is based upon certain normal anatomic peculiarities which figure in the lodgement and formation of urethral calculi and depends upon the following characteristics. The external urinary meatus is the narrowest portion of the urethra, and has back of it an expansion, the fossa navicularis, which terminates posteriorly by a narrowed communication leading to the pars pendula. Anteriorly the bulbous urethra has a nar-

TABLE I. (ENGLISCH).

Age.	Number.	Fossa Navicularis.	Pars Pendula.	Pars Scrotalis.	Pars Bulbosa.	Pars Membranica.	Undetermined.
1	5	1	2	1	0	1	0
2	23	2	1	6	4	7	3
3	6	2	1	2	1	0	0
4	14	7	1	1	1	4	0
5	6	1	2	0	1	1	1
6	12	1	3	2	1	3	2
7	5	1	0	1	0	2	1
8	4	1	1	0	1	1	0
9	7	1	1	1	2	2	0
10	10	1	1	0	4	3	1
11–15	35	4	1	5	7	17	1
16–20	22	2	4	4	2	6	4
21–25	26	3	2	3	2	16	0
26–30	15	4	2	2	0	7	0
31–35	15	0	1	1	4	8	1
36–40	24	2	3	5	5	5	4
41–45	23	2	3	1	4	11	2
46–50	27	0	6	2	8	8	3
51–55	11	1	0	2	2	5	1
56–60	12	0	0	2	2	8	0
61–65	3	0	0	1	0	2	0
66–70	13	0	5	1	1	5	1
71–75	4	0	0	2	0	2	0
76–80	2	0	0	0	0	1	1
Undetermined	81	15	13	5	16	24	18

TABLE II. (ENGLISCH).

	Urates.	Oxalates.	Phosphates.	Urophosphates.	Oxalat. Phosphates.	Kohlen. Phosphate Kalk.
Fossa Navicularis . . .	3	4	2	1	1	0
Pars Pendula	5	2	6	6	1	2
Pars Scrotalis	5	1	5	4	0	0
Pars Bulbosa	2	6	4	2	0	1
Pars Membranica . . .	4	2	9	4	4	1
Undetermined	2	1	1	2	1	0
Total	21	16	27	19	7	4

rowed outlet, while posteriorly the transition is effected through the resistant anterior leaflet of the triangular ligament into the pars membranica, which has a corrugated surface and is easily distensible. Thus we have a constriction or resistance and a distended or distensible portion posterior to it, where any object

passing along the urethra may be arrested, and yet not completely occlude the canal. Under such occasions there may be a ball-valve action of the calculus, a phenomenon well illustrated by some of the reported cases, and also in another case which came under my observation recently, where the calculus had passed all obstructions down to the fossa navicularis, causing partial obstruction at intervals, until, at the external meatus, occlusion became complete and could only be removed by surgical means. Besides these physiologic anatomic conditions, we have certain pathologic ones which play even greater part in securing lodgement or aid in the formation, *in situ*, of such calculi, and will be discussed later.

As to age, Table I shows that, although distributed over four-fifths of the century at certain periods, we have increased prevalence. Especially early, at about the second year, the number of cases is high, perhaps due to congenital narrowness of the urethra. Again, from the eleventh to the fifteenth year, during adolescence, where we may assume, according to Englisch, that the hyperæmia incident to puberty is a factor. Another favorable period is early manhood, when inflammatory reactions, gonorrhœal or traumatic, are prone to occur and constitute some organic obstruction or form material for an organic nucleus for future deposit, while between thirty-five and fifty strictures resulting from such inflammations play an important part.

The chemical composition has also been studied in ninety-four of the reported cases and judged to be as given in Table II. In the case under discussion, a complete chemical analysis was made, and the calculus was found to be purely phosphatic, with a minimum amount of organic material. (Analysis of the different layers being made separately.)

Although but few cases have been reported where the higher urinary passages showed an associated condition, Kaufmann and Englisch hold that calculi retained in the urethra are usually secondary, having been preformed at higher levels and arrested in their passage, but they may be greatly modified after having become lodged. This may be true where the urethra is

normal and perhaps with urate and oxalate calculi, yet there are cases where the primary origin in the urethra seems undoubted, especially where there coexists dilatations or diverticulæ of considerable size, where urinary stasis can take place, similar to that in the pelvis of the kidney or in the bladder. Such diverticulæ can originate in various ways and may be true, containing all the coats of the normal urethra, or false, being a sac communicating with the urethra, but containing none or only parts of the coats, although often lined with a membrane which closely resembles the normal mucosa. True diverticulæ may be primary, and, as such, may be congenital or acquired. The congenital forms may arise in various ways, namely, (1) failure of the genital folds to unite for their entire extent, thus leaving fissures or pockets; (2) agglutination of the urethral surfaces at the narrowest parts above mentioned during the first few months of intra-uterine life and a resulting dilatation posterior to the same; (3) congenital strictures or valves may cause a similar result. As previously stated, true diverticulæ may also be secondary or acquired, and then usually follow strictures of inflammatory origin, mainly gonorrhœal, but occasionally traumatic. More rarely they follow lodgement of a calculus in a normal urethra, with accompanying pressure atrophy and absorption of the surrounding tissue. False diverticulæ, the anatomy of which has already been alluded to, are cavities communicating with the urethra following periurethral abscess (Kaufmann), or rupture of the urethra with urinary infiltration and resulting breaking down of the tissues involved (Englisch). Occasionally we have a pocket formed in the pars bulbosa by a distention of Cowper's glands with inflammatory products (Englisch).

In the case under discussion we have evidently one of primary urethral calculus. The sac is that of a true diverticulum in structure; whether congenital or acquired late in life cannot be demonstrated, but evidence is in favor of the former, as no organic stricture can be detected anterior to the same. The nucleus of organic matter is readily explained by the early gonorrhœa, with, perhaps, injections as treatment. This nucleus,

floating anteriorly, as far as possible, had added to it, mainly posteriorly, layer after layer of phosphatic deposit until the present dimensions have been reached, the smaller concretions forming between it and the wall of the sac as the calculus became less mobile. The urine showed marked acidity, and, as the patient was suffering from cirrhosis of the liver, for that time has probably been acid, favoring deposits of oxalates and urates instead of phosphates (Purdy). Therefore the entire concretion has presumably antedated this malady. It may, however, have occurred at a period when the urine was alkaline from a complicating cystitis, during periods of phosphaturia, or, perhaps, the alkaline tide, the alkalinity after meals being sufficient to secure phosphatic deposit which the acidity of the interim was unable to dissolve.

BIBLIOGRAPHY.

Englisch, J. Über eingelagerte und eingesackte Steine der Harnröhre. Archiv für klinische Chirurgie, 1904, lxxii, 487.

Englisch, J. Über angeborne Verengerungen und Erweiterungen der männlichen Harnröhre. Archiv für Kinderheilkunde, 1881, ii, 85, 291.

Englisch, J. Über Obliteration und Erweiterung der Ausführungsgänge der cowprischen Drüsen. Jahrbücher der Gessellschaft der Ärzte in Wein, 1883.

Kaufmann. Text-book, Specialle Pathologische Anatomie II Auflage, 1901, 754 (Berlin).

Purdy. Practical Urinalysis and Urinary Diagnosis, 5th Edition, 1900, 56; also 350 (Philadelphia, Pa.).

CASE OF BONE TRANSFERENCE.

USE OF A SEGMENT OF FIBULA TO SUPPLY A DEFECT IN THE TIBIA.

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THE following case illustrates the possibility of supplying a tibial defect amounting to absence of nearly the entire diaphysis by the appropriation of a corresponding portion of its companion, the fibula.

In a paper published in the *Journal of the American Medical Association*, February 3, 1904, Nichols, of Boston, discussed this subject very ably and at great length. In this paper the author reported eleven cases, showing that in many instances, particularly where the defects were of minor dimensions, by preserving the periosteum, there was complete reproduction of bones with the attainment of satisfactory results so far as weight-bearing and function were concerned. Two of Nichols's cases were similar to my own, in that there was almost entire loss of the diaphysis of the tibia. In the first of these cases, after four months, a radiogram showed nearly complete regeneration of the shaft, but with a conspicuous deformity due to marked anterior bowing. At this time the patient disappeared, and there was no record as to functional end result. The second case was reported as a functional failure after the lapse of several years.

In entering upon this undertaking, I recognized that a central segment of the fibula firmly fixed to the tibia at both ends by bony union would carry with it its own nutrient supply, and that this would be largely increased by the more generous nutrition of the host. Assuming this to be true, I reasoned that the bridge of fibula so formed would rapidly expand, and in reasonable time approximate the dimensions of the larger bone,

thereby insuring a satisfactory condition as regards weight-bearing.

Furthermore, I believed that, as the important relations of the lower extremity of the fibula were to remain undisturbed, the integrity of the ankle-joint would be preserved and locomotion be unimpeded.

The early history of the case is that of an acute, infectious, osteomyelitis of the left tibia. The patient was a lad of seven years, who entered the City and County Hospital of San Francisco in May, 1902. Family history was unimportant. The trouble began a few days before entrance. At that time, while at play, he sustained a slight injury to the left leg just below the knee. Leg became swollen, tense, and acutely tender. There was high temperature succeeding a chill. The attending physician made a small incision about three inches below the knee, from which, at time of admission, there flowed a small amount of clear yellow fluid. Tibia was extensively denuded, and near the ankle there were two red fluctuating areas. An incision along the spine of the tibia from the tubercle to one inch above the ankle-joint revealed the fact that nearly the entire shaft was disintegrated. Pus oozed through several sinuses leading to the medullary cavity. On stripping the periosteum, the cortical portion of the bone was readily scooped out with a curette, leaving a trough of periosteum. Having in mind the possibility of bone reproduction, the periosteum after being carefully cleansed was stitched into a tube of small caliber. The wound was drained, partly closed, and the leg laid upon a posterior splint. For three months there was gradual and satisfactory progress and the wound was fully healed. Six months later, despite an apparent effort on the part of nature to reproduce the tibia, there was still an interval of about five inches between the upper and lower fragments, and progress in this direction seemed to be practically suspended. At this time the leg could not be extended upon the thigh, but hung loose, flail-like, and utterly useless. (This is shown in the small photograph, Fig. 1.)

On January 27, 1903, I finally determined to supply the defect by sawing the fibula at a point opposite the lower end of the upper tibial fragment and attaching it thereto. This was done without difficulty, and the divided end of the fibula was firmly

FIG. 1.—Condition on admission.

FIG. 2.—Radiogram showing condition of bone eight months after operation.

FIG. 3.—Radiogram showing condition thirteen months after operation.

FIG. 4.—Condition on discharge.

planted in a cup-shaped depression in the tibia, as above described. At this time the diameter of the fibula was about that of an ordinary lead-pencil, or approximately one-third of the diameter of the normal tibia at a corresponding point. Union was tolerably slow, but solidification was finally noted six months later, July, 1903.

The following note was made September 20, 1903: "The lad walks with the limb encased in two lateral splints as a support to the ankle-joint, there being a tendency for the foot to evert when the patient stands upon the affected member." (The then condition is shown by the radiogram, Fig. 2.)

Not satisfied with the weight-bearing condition at that time, I concluded to transfer the lower end of the fibula to the lower fragment of the tibia, which was done October 6, 1903. At this time it was noted that, during the six months when the lad walked with slight foot eversion, there was effected a permanent change in the conformation of the tarsus, resulting in an outward alignment of the axis of the lower fragment of the tibia. It was impossible to correct this condition, and a noticeable deformity in the present contour of the limb finds its explanation in this fact. The operative wound healed kindly, and on February 15, 1904, perfect bony union was secured. (See radiogram, Fig. 3.)

Since that time the patient has progressed admirably. The limb, though three-quarters of an inch short, has assumed the dimensions and in a general way the contour of the normal member (Fig. 4). Careful measurement of the transferred portion of the fibula shows that its diameter is now three-quarters of an inch, or practically the same as the opposite tibia. The lad goes to school, plays ball, and joins in the ordinary sports of other boys, and, despite the lateral deformity and slight shortening, he walks without support and with only the suggestion of a limp.

In a similar case I should certainly insist upon the affected member being kept at rest until the second transposition could be effected, thereby avoiding the deformity, which is the only serious defect in this case. Considering the extensive destruction of the tibia which occurred prior to his admittance to my service, I can conceive of no other method which would have offered a result in any sense so satisfactory as the one adopted.

CONTRECOUP FRACTURE OF THE STERNUM.[1]

BY GEORGE DE TARNOWSKY, M.D.,
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CASE HISTORY.—Mr. P., aged forty-three years, on April 28, 1904, while cleaning car-windows, was thrown from the ladder on which he was standing. His fellow-workmen stated that he fell on his head and his body bent forward and "doubled up on itself." In other words, after striking the ground, his body completed a somersault, and he landed on his feet in a doubled-up condition. When called to see him a few minutes after the accident, I found him semidelirious, bleeding profusely from scalp wounds, and complaining during lucid intervals of pain in his chest. An extensive stellate scalp wound over the left parietal eminence made examination of the skull easy; no fracture or depression was noted, and the wounds were sutured. Examination of the thorax showed a distinct protuberance over the sternum at the level of the second and third chondrosternal articulations. Tenderness over this area was exquisite and slight crepitus was probably elicited once, but the great pain forbade confirmation of this symptom. There were no external discolorations, bruises, or marks such as would undoubtedly have been present had the patient's sternum struck any solid body in falling. The man was sent home and put to bed with hot moist dressings over the sternum. The scalp wounds healed *per primam*, and will not be further considered in this paper.

April 29. Patient bedridden; temperature, 101° F.; pulse, 104; respirations, 34. The midsternal region is discolored; the protuberance has increased and tenderness is still very acute. An attempt was made to keep patient's head and shoulders thrown back in order to reduce the deformity, but we had to desist on account of increased pain and discomfort. Adhesive strips over the fractured area were also tried, but promptly discontinued, as they only aggravated the pain. The patient coughs frequently, and on two occasions the sputum was tinged with blood. Respi-

[1] Read before the North Shore Medical Society, December 6, 1904.

ratory movements are shallow and extremely painful, and cough is apparently agonizing. On auscultation, a number of large moist râles are heard over both sides of the chest anteriorly. Percussion showed slight dulness over the anterior mediastinum above the fracture. The heart sounds are normal, except for a rather marked accentuation of the second aortic sound, which could be accounted for by the well-marked arteriosclerosis.

April 30. Temperature, 100° F.; pulse, 94; respiration, 32. Patient required opiates for pain. Hot linseed poultices applied to sternum. Cough persists, but pulmonary findings are negative, with the exception of a few fine moist râles over the right lung anteriorly. The patient's general condition improved daily, and no further symptoms developed until May 5, on which date he was seized with cramp-like pains in both upper extremities. He said he felt as though "somebody was gripping his arms tightly." These pains lasted from one to three minutes and reappeared several times daily for about a week. There was coincidently some pain on pressure over the fifth, sixth, and seventh cervical vertebræ; but no deformity could be made out, and there was at no time any external evidence of injury. There were no motor disturbances, but the man complained for several days of numbness and tingling in both upper extremities. By the end of the first week he was able to walk around the house. The patient's attitude was very characteristic,—body bent forward, head slightly flexed to the left, rapid shallow respiration and immobile thorax. The lungs cleared up satisfactorily, respirations gradually returned to their normal rate and quality as the pain decreased, and on May 19, when patient was discharged, the findings were as follows: At the level of the second costal cartilages, the sternum forms a distinct palpable ridge, the lower fragment overlapping the upper to a very slight extent. The callus is dense; there is no tenderness or pain, and the dulness over the anterior mediastinum has disappeared. Palpation of the spinal column is negative, and there have been no sensory disturbances in the upper extremities for a week. At present writing the patient's condition is satisfactory in every respect.

Fractures of the sternum are extremely rare. Malgaigne[1] saw one case in eleven years' service at the Hôtel-Dieu in Paris; Lounsdale collected reports on two cases out of a total of 1901

fractures in the Middlesex Hospital service; Roland had two cases in five years' service in Guy's Hospital, London. Arbuthnot Lane stated that he had seen four cases of fracture of the sternum alone. Grant,[2] speaking of fractures of the sternum, said, "I have seen but one case, . . . and that occurred in connection with fracture of the spine." Of indirect or contrecoup fractures, Servier,[3] in 1889, could only collect eighteen to twenty cases. In the literature at my disposal I have been able to add seven new cases since 1889. Of these, one was in all probability due to muscular action.

Fractures of the sternum may be due to (*a*) Direct, (*b*) Indirect violence, (*c*) Muscular action. The majority of cases are direct fractures, simple or compound, single or multiple, as a rule associated with other bony or visceral lesions; they differ in no respect from fractures of other bones, and will not be considered in this paper. The rare cases of fracture from muscular action are apparently caused by forcible backward flexion of the vertebral column with coincident tension of the recti and sterno-cleidomastoidei muscles, wrenching the sternum apart. Chaussier [4] reports two such cases occurring in young women during labor. They were both in a position of extreme opisthotonos when the accident occurred. Lucchetti and Posta,[5] Comte and Martin,[6] and David, Sabatier, and Roland quoted by Hamilton,[7] all mention similar cases. Dubois [8] gives the history of a clown who, while doing the backspring, fractured his sternum. Irwin [9] reports the case of a coachman who, while seated on top of his omnibus, was dragged by his unruly team through a low doorway. His body was violently bent backward, resulting in a fracture of the sternum.

Contrecoup fractures and dislocations almost invariably occur at the junction of the manubrium and gladiolus. They are usually transverse, but may be oblique or T-shaped. In 85 per cent. of the cases analyzed, the gladiolus was found to override the manubrium; in 15 per cent., the reverse held true or there was fracture or dislocation without overriding. It is often impossible to differentiate dislocation from actual frac-

ture; the former cannot, of course, be present when bony union has occurred between the manubrium and gladiolus.

Etiology.—Contrecoup fractures or dislocations of the sternum are produced in a variety of ways. A brief description of a few typical cases will help us to understand the mechanism of at least a majority of these lesions.

CASE I.—Costa de Sarda.[10] A male patient, aged forty-five years, threw himself from a third-story hospital ward, landing on his buttocks. Three fractures of the sternum were found post-mortem, but no evidence of external injury over that bone.

CASE II.—Velpeau.[11] A middle-aged man fell from a cart, landing on his back. Fracture of the upper part of the sternum was diagnosed.

CASE III.—Lafont.[12] Man, fifty-eight years old, fell backward from a cart, landing on his back. A fracture of the sternum was found, with the lower fragment overriding the upper one. The patient also had a hæmatoma in the left axilla, and died of septicæmia. It was found post-mortem that the fracture had occurred one centimetre above the articulation of the manubrium and gladiolus.

CASE IV.—Rivington.[13] An acrobat, thirty years old, while turning double forward somersaults, fell ten feet on the back of his head, which was thus forcibly flexed on the chest. There was found a fracture of the intervertebral substance between the sixth and seventh cervical vertebræ, and an oblique fracture of the upper sternum. Rivington believed that the forcible flexion of the chin on the sternum caused the fracture.

CASE V.—Ibid. Man, aged thirty-seven years. While walking in the street, a piece of scaffolding fell on his head, crushing his hat and tearing the scalp from the skull. It was found that he had suffered a fracture of the spinous processes of the third and fourth dorsal vertebræ, also a forward dislocation of the gladiolus on the manubrium.

CASE VI.—Ibid. A heavy bag of seed fell from a height of forty feet on a man's head, striking him between the shoulders. The spinous processes of the six upper vertebræ, the six upper ribs on the left side, and the sternum at the level of the second ribs were fractured.

CASE VII.—Hodgen.[14] A man, aged thirty-eight years, fell a distance of twelve feet, striking on his shoulders and back. The usual type of sternal fracture, with fractures of the spinous processes of the sixth and seventh dorsal vertebræ, were found.

CASE VIII.—Battersham[15] reported the case of a miner who was struck across the shoulders and occiput by a falling mass of coal, which "doubled him up head flexed on chest." A transverse fracture of the sternum was found at the junction of the manubrium and gladiolus.

CASE IX.—Tuttle.[16] A man, thirty-four years old, dived in the surf from a wooden pillar six feet high, striking (presumably) with his hands on the sandy bottom. The attending physicians thought he must have struck his head on the sand, but as none could be found in his hair, and

there was no scalp injury, it was reasonable to suppose that the patient was in the characteristic diver's attitude at the time of the accident. On examination, a dislocation of the first and second portions of the sternum was found, together with a fracture one and three-fourths inches below the luxation.

CASE X.—Moerlin [17] wrote a thesis based on two cases. One of them was a contrecoup fracture of the sternum produced by a fall from a wagon; the other was probably due to direct violence.

CASE XI.—Cale.[18] A middle-aged man was thrown from his buggy and fell on the back of his head. Extensive scalp wounds were found with a fracture of the sternum.

CASE XII.—Dubreuil.[19] A mason fell from a scaffolding, striking the ground with his back. The sternum was found to be fractured in three places.

CASE XIII.—Watts.[20] A woman, fifty-eight years old, fell backward from a wagon, landing on her shoulders, and fractured her sternum.

CASE XIV.—Stone and Cotton.[21] While doing gymnasium work, a boy, twenty-one years old, fell with his chin flexed on the sternum, the brunt of the fall being received on the occiput and back of the neck. The gladiolus was found dislocated behind the manubrium.

CASE XV.—Van Horn.[22] A man, sixty-three years old, fell from a tree a distance of twenty feet, landing on the back of his head and shoulders and forcibly bending his body forward. A fracture at the junction of the first and second pieces of the sternum was found; also a fracture of the fourth costal cartilage on the left side.

CASE XVI.—Turner.[23] An elderly man was caught between a cross shaft and a descending elevator, his body and head forcibly flexed forward. Post-mortem a fracture of the sternum at the level of the second ribs was found, together with a laceration of the trachea and a hæmatoma at the anterior mediastinum.

We can now formulate the following propositions: (1) Contrecoup fractures of the sternum are produced in a majority of cases by falls on the head and shoulders. (2) The thorax is brought in forcible anteflexion, *i.e.*, doubled up on itself. (3) The lesion is nearly always situated at the junction of the manubrium and gladiolus. (4) The gladiolus usually overrides the manubrium. (5) The nature of the lesion will depend on (*a*) whether bony union of the joint had taken place, (*b*) on the variety of joint present. Rivington's statistics (*loc. cit.*) show amphiarthrosis, 51 per cent.; diarthrosis, 32 per cent.; intermediate (incomplete separation of the two pieces), 11 per cent.; ossified only 6 per cent. The exact mechanism of these fractures is still an unsettled point. We shall briefly review the

most widely accepted theories and endeavor to evolve from them all a "working theory" which can be applied to a majority of these accidents.

Maisonneuve[24] taught that contrecoup fractures of the sternum were produced by falls on the scapula. On striking the ground, the scapulæ encounter a resistance which is transmitted through the clavicles to the manubrium. At the same time, the compression of the body-weight caused by the fall is brought to bear on the gladiolus through the ribs and corresponding costal cartilages. This pressure on the gladiolus is all the more powerful if the vertebral column is brought in forcible anteflexion below the level of the manubrium, because flexion of the vertebræ transmits to the gladiolus through the lower ribs a part of the shock incident to the fall. In other words, he believes that the clavicles form a solid buttress, and that in falls on the neck and shoulders they transmit the shock to the sternum from above, while the middle and lower ribs convey it from below.

Arbuthnot Lane[25] has shown by experiments on the cadaver that heavy blows on a padded shoulder will produce fracture of the sternum. He claims, however, that in falls causing a fracture of that bone, the force is transmitted, not from the clavicle to the sternum directly, but only through the first and second ribs. The clavicle, he says, rests on the anterior extremity of the first rib, just outside its union with the cartilage. Regarding the clavicle as a lever whose inner extremity is fixed by ligaments which connect it with the upper part of the manubrium, and so form the fulcrum, the short arm of the lever corresponds to the portion of clavicle between its inner extremity and the point where it crosses the first rib, its whole length forming the long arm. If force be applied vertically to the outer extremity of the clavicle, the manubrium is acted on by two forces in different directions, but conspiring to wrench the upper piece of the sternum from the remainder of the bone. The one force is the tension exerted on the upper part of the manubrium by the sternoclavicular ligaments; the other is a much greater force exerted on the manubrium by means of the first rib and cartilage, owing to the pressure exerted on it by

the clavicle. These two forces acting together tend to cause the manubrium to rotate around an anteroposterior axis. The essayist closed his remarks by saying, " I do not wish to convey the idea that I believe the sternum can only be broken by means of the clavicle and first rib, but that it is one means."

T. J. Tuttle (*loc. cit.*) explains contrecoup fractures of the sternum as follows: Fracture may be produced by falling upon the outstretched hands, the force being transmitted hence through the clavicles and first ribs to the upper portion of the sternum. The force thus expended on the manubrium is a downward (with reference to the body) and backward force, while that exerted upon the gladiolus by the momentum of the body and abdominal viscera through the diaphragm and lower ribs is an upward and forward one. These two forces acting at variance, a fracture or dislocation of the sternum is produced.

Helferich [26] thinks that in forcible anteflexion of the head, the chin presses against the upper edge of the manubrium. The sternum is then compressed in its longitudinal axis until it snaps. If such were the case, one would certainly expect to find some injury to the soft tissues of the chin; no mention is made of such a finding in any of the reported cases. Servier (*loc. cit.*) is of the opinion that all contrecoup fractures of the sternum are produced by falls on the neck and shoulders or by pressure on the vertebral column. His theory is that falls on the head, shoulders, or back all tend to force the ribs and costal cartilages forward and upward (the body lying on the horizontal plane), *i.e.*, the ribs tend to meet in the median line. This fact he demonstrated satisfactorily on a manikin provided with flexed wires in lieu of ribs. In order to appreciate the accuracy of Servier's theory, we must consider fully the anatomic conditions confronting us. The thorax is an osseocartilaginous cage, conical in shape, being narrow above and broad below, flattened from before backward and longer behind than in front. Its posterior surface is formed by the twelve dorsal vertebræ and the posterior parts of the ribs. The anterior surface is slightly convex and inclined forward from

above downward; it is formed by the sternum and costal cartilages. The lateral surfaces are formed by the ribs and intercostal spaces (Gray). The posterior part of the thoracic cavity (*i.e.*, the vertebral column) is much more mobile than the anterior or sternal portion. The ribs increase in length from the first to the seventh, and decrease in breadth and strength from above downward. Their movements are along two axes of rotation, both tending to increase the anteroposterior diameters of the thorax.[27] The range of motion of the ribs increases from above downward. Movements of the costal cartilages are of necessity accompanied by an upward and forward movement of the sternum to which they are attached, this movement being greater at the lower than at the upper end of the latter bone. Of the component parts of the sternum, the first piece or manubrium articulates with the clavicles, first pair and part of the second pair of ribs. Union with the gladiolus rarely takes place except in old age (Gray, Quain, Debierre). The four segments of the gladiolus begin uniting at puberty from below upward, so that by the age of twenty-five this portion of bone consists of one piece. The gladiolus and third to seventh pairs of ribs may therefore be said to act as a unit. Quite early in life, the first costal cartilages ossify, becoming continuous with the manubrium, of which they now form a part. The second costal cartilages are united to the manubrium in the upper two-thirds of their articular surfaces by fibrillated cartilage, and lower down to the plate of fibrocartilage between the manubrium and gladiolus. The lower third of the articular surfaces of the second costal cartilages form an arthrodial articulation with the gladiolus. This explains why the second pair of ribs remains connected with the manubrium in dislocations or fractures of the sternum (Lane, *loc. cit.*). Intrathoracic pressure, *i.e.*, pressure in the thoracic cavity outside of the air-passages, is ordinarily negative, but becomes positive during forced expiration, especially if there is some obstruction to the exit of air. Sudden blows on the thorax will tend to force air out, provided the glottis is not closed.[28]

Bearing these anatomical facts in mind, we can follow

Servier's theory, which is briefly as follows: Falls on the head, shoulders, or back press the ribs forward and upward, the range of motion increasing from the first to the seventh pair. This upward motion is perforce transmitted to the sternum, which is thus caught between two forces acting in opposite directions. The weakest portion of the sternum gives way and a fracture or dislocation results. The manubrium, being solidly fixed by the short, strong, upper ribs, retains its position, whereas the gladiolus, articulating with longer, more motile ribs, is thrown upward and overrides the first bone.

Two supplemental forces should, in our opinion, be added to those already mentioned, namely, intrathoracic pressure and the action of the second pair of ribs and costal cartilage. (*a*) We have already mentioned the fact that intrathoracic pressure becomes positive during forced expiration, especially when there is obstruction to the exit of air from the lungs. This is precisely the condition present at the time of a fall. The person draws a sudden deep breath and closes the glottis. The shock of the fall tends to force air from the lungs, but the tense glottis prevents its immediate escape, and positive pressure is exerted against the thoracic wall. We can thus consider the thorax as a temporarily closed cavity and look upon fractures of the sternum as due in part, at least, to a "bursting" force, similar to that which is present in contrecoup fractures of the skull. (*b*) The second pair of costal cartilages are united to the manubrium by fibrillated cartilage, but form an arthrodial articulation with the gladiolus. The forward and upward movement of the ribs in falls on the head or shoulders tends to wedge the second costal cartilages between the two portions of the sternum, producing a diastasis or fracture of the intervening cartilage.

SUMMARY OF FACTORS PRODUCING CONTRECOUP FRACTURES OF THE STERNUM.

(1) Falls on the head or shoulders press the ribs forward and upward, the range of motion increasing from the first to the seventh pair.

(2) The clavicles may sometimes act as a lever and help to wrench the nanubrium from the gladiolus. This is especially true in falls on the extended hands.

(3) Intrathoracic pressure at the time of the fall exerts a positive pressure on the thoracic wall.

(4) The second costal cartilages act as a wedge, tending to separate the manubrium from the gladiolus.

Pathologic Anatomy.—Rivington's statistics show that only in 6 per cent. of all cases does there exist bony ankylosis of the manubrium and gladiolus. A genuine fracture can therefore only occur in a comparatively small percentage of cases. Rivington's "intermediate cases" (11 per cent.) can be added to the genuine fractures, as in them there is at least superficial ossification of the sutural cartilage. It is probable that in a small proportion of the specimens classed as amphiarthrodial, there was some cartilaginous or fibrous union between the manubrium and gladiolus. We must nevertheless conclude that a majority of the so-called fractures of the sternum are in reality dislocations, with or without rupture of the sutural cartilage. Ashhurst [29] correctly said that dislocations were usually due to contrecoup or muscular action, whereas fractures were usually the result of direct violence. He, however, incorrectly advises us to infer dislocation and absence of fracture when the gladiolus overrides the manubrium. The anterior sternal ligament is torn whenever the lower fragment overrides the upper one. The posterior ligament is partly detached but remains intact. The second pair of ribs remains with the manubrium. Union may be bony or fibrous. Arbuthnot Lane (*loc. cit.*) has seen several cases of ununited fracture of the sternum in the dissecting-room.

Diagnosis.—Hamilton (*loc. cit.*) wisely states that "the frequent occurrence of congenital malformations of the sternum should warn us to exercise great care in our examinations, lest we mistake these natural irregularities for fractures." The same writer includes fractures and dislocations of the sternum in all of his remarks, as he very properly asserts that a differential diagnosis between these two conditions is usually impos-

sible. The classical symptoms of fracture or dislocation of the sternum are: (1) Severe pain at the junction of the manubrium and gladiolus; this pain increases during inspiration, coughing, or attempting to move the head in any direction. (2) The patient's attitude is rather characteristic. He stands or sits with head bent forward and usually to one side; respirations are short and shallow, and movements of the head or thorax are slow and cautious. A severe case of torticollis would give the same picture. (3) On inspection, a rather sharp bulging is seen just above the level of the second costal cartilage. (4) Palpation may or may not elicit crepitus; the gladiolus overrides the manubrium in 85 per cent. of all cases. Malgaigne (*loc. cit.*) states that with flexion of the head and overriding of the fragments one can diagnose a fracture due to forward flexion of the thorax; absence of overriding or diastasis of the sternum indicate fracture due to backward flexion of the thorax. (5) Percussion is negative unless a hæmatoma of the anterior mediastinum has formed, in which case we may find impaired resonance over the upper retrosternal region. We have found no cases of compound fracture due to contrecoup.

Prognosis.—The majority of cases make a very satisfactory recovery, regardless of the form of treatment instituted. Fatal issues are all due to associated injuries or complications following the injury. Fracture of the trachea, hæmatoma, emphysema, bronchitis, and fatal shock have occurred in these cases. In uncomplicated fractures, the fragments unite rapidly (three to four weeks), but the fracture is not solid for eight weeks. Union by overlapping is the rule, but function is restored.

Treatment.—The severe pain may require opiates during the first forty-eight hours. The patient should be kept in his room, well protected from sudden chilling of the body, as bronchial affections are to be avoided on account of the extremely painful coughing which they induce. Hot applications in the form of poultices or plastic dressings are very grateful to the patient. When lying down, a small, hard pillow should be placed between the scapulæ, and the head should be low.

Actual reduction of the displacement may be easy or impossible, and once reduced, the fragments tend to spring back to their former malposition. Stone and Cotton (*loc. cit.*) reduced a fracture in the following manner: The patient was placed so that the angles of the scapulæ rested on the end of the operating table, while an assistant lay across him and fixed the legs and pelvis. The spine was then strongly extended by traction downward, applied to the chin and occiput, and the arms were brought upward and outward, the patient resisting the outward rotation. He was then directed to cough and the fragments readily slipped back. The object of the outward rotation of the arms was to give more direct traction, through the tense pectorals, on the upper rib insertion of the muscles and so, indirectly, on the manubrium. Plaster-of-Paris jackets were satisfactorily used by Cale and Hodgen. A pad on the lower fragment, with figure-of-eight bandage to keep the shoulders pulled backward, may be sufficient. A Taylor steel back brace with apron and head support may be necessary in order to immobilize the fragments. Operative treatment is only indicated in the presence of alarming pressure symptoms as evidenced by cynaosis and dyspnœa, or when an abscess of the anterior mediastinum has occurred. A median incision over the upper sternum is made, and reduction accomplished by means of hooks or tenaculæ. A gimlet may be used to elevate the fragment. Trephining the sternum has been resorted to when drainage is required. Ligation of the internal mammary artery has been necessary. While the sternum is broken less often than any other bone (1 per cent. of all fractures, according to Hoffa), we would conclude this paper by advising a routine examination of the anterior thoracic wall after all falls on the head, shoulders, extended arms, or pelvis.

REFERENCES.

[1] Malgaigne. Dict. Encyclopedique des Sciences Med., Vol. xii.
[2] Grant. International Clinics, July, 1899, p. 69.
[3] Servier. Gazz. Heb. de Méd. et Chir., 1889, p. 155.
[4] Chaussier. Revue de Médicine, 1827.
[5] Lucchetti and Posta. Boll. delle Sc. Med. di Bologna, 1857.

[6] Comte and Martin. Bull. Soc. Anat., Paris, 1826.
[7] Hamilton. Text-Book on Fractures.
[8] Dubos. Thèse de Paris, 1835.
[9] Irwin. Medical News, June 23, 1888.
[10] Costa de Sarda. Gazz. des Hôp., Paris, 1853, p. 413.
[11] Velpeau. Gazz. des Hôp., Paris, 1864, p. 221.
[12] Lafont. Bull. Soc. Anat., Paris, 1867, p. 327.
[13] Rivington. Medico-Chirurgical Transactions, 1874, p. 101.
[14] Hodgen. Medical Record, New York, 1877, p. 805.
[15] Battersham. Lancet, 1884, p. 425.
[16] Tuttle. Medical Record, New York, 1885.
[17] Moerlin. Jahresbericht der Med., 1887, p. 412.
[18] Cale. International Journal of Surgery, 1890, p. 173.
[19] Dubreuil. Gazz. des Hôp., Paris, 1891, p. 651.
[20] Watts. St. Louis Clinique, 1892, p. 263.
[21] Stone and Cotton. Boston Medical and Surgical Journal, 1897, p. 313.
[22] Van Horn. University Medical Magazine, 1897, p. 726.
[23] Turner. Lancet, November 5, 1898.
[24] Maisonneuve. Archives Gén de Méd., 1842, p. 249.
[25] Arbuthnot Lane. Transactions of Pathological Society, London, 1884–85.
[26] Helferich. Text-Book on Fractures.
[27] Halliburton. Kirke's Physiology.
[28] Hall. Text-Book on Physiology.
[29] Ashhurst. Medical and Surgical Reporter, 1881, p. 484.

FRACTURE OF THE CARPAL SCAPHOID, WITH HABITUAL DISLOCATION OF THE CENTRAL FRAGMENT.

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OF SAN FRANCISCO.

STIMSON (ANNALS OF SURGERY, Vol. xxxv, page 574) has reported two cases of scaphoid fracture with dislocation of one of the fragments, and has collected from the literature three similar cases. The following is especially interesting, as it is to my knowledge the first case of habitual dislocation to be reported.

E. D., laborer, aged thirty-two years, presented himself at my service in the Dispensary Clinic of the University of California, department under Professor Harry M. Sherman, on November 1, 1904, for a forward metacarpophalangeal dislocation of the little finger, right hand. While the finger was being dressed the patient called my attention to his left wrist, which he said had been injured three years before. On the anterior surface of this wrist and directly over the scaphoid carpal was a small bony prominence about the size of a pea. This could be reduced with slight force when the hand was flexed upon the wrist, but remained dislocated in all other positions in which the hand was placed.

A radiograph showed a transverse fracture of the carpal scaphoid, the dislocated bone being the small fragment adjoining the os magnum and semilunar. The patient could dislocate the fragment easily, effecting this several times for me by grasping tightly the edge of the operating-table. He stated that the dislocation frequently occurred when he worked with pick and shovel, but he had always been able to reduce it readily. The left hand was as strong as the other, and all the movements of the hand and wrist were normal. The patient complained only of a slight grinding in the wrist at times, but said that it was never accompanied by pain.

On inquiry, he stated that the injury had been caused by a fall three years before while attempting to board a moving street-car. He was in a drunken condition at the time, but remembered having grasped the car-rail with his left hand and having been thrown forcibly to the pavement. He could give no further details of the accident. The wrist was greatly swollen for a period of three months following the injury, during which time he received no surgical attendance. Full function returned in about one year's time.

INTERSCAPULOTHORACIC AMPUTATION.

REPORT OF OPERATION FOR SARCOMA OF THE HUMERUS.

BY FARRAR COBB, M.D.,

OF BOSTON, MASS.,

Surgeon to Out-Patients at the Massachusetts General Hospital.

THE following case is interesting because of the great rapidity of the growth of the disease, the associated pain, the technique of the operation, and the complete absence of surgical shock, the successful immediate result and the disappointing ultimate result, certain pathological conditions in the specimen, and the excellent X-ray plates of the tumor.

The patient was a young adult, a member of the fire department in Wakefield, Massachusetts, with an unimportant family history and an entirely negative previous personal history. It is noteworthy that only eight weeks before the operation did this more than ordinarily intelligent man notice anything wrong with his arm. At that time his arm began to feel weak, and he could not raise the elbow from the side without pain in the shoulder. He thought there was "crackling" in the joint when he first began to notice the weakness and pain. He was treated for two weeks by a Wakefield physician and then came to the Out-Patient Department of the Massachusetts General Hospital, where a diagnosis of muscular rheumatism, or bursitis, was made, and massage and hot and cold douching ordered without any relief. Four weeks before operation, enlargement of the shoulder was first noticed by him.

The patient entered the South Surgical Service of the Massachusetts General Hospital on October 23, 1903. Through the kindness of Dr. Beach, the senior surgeon of the service, the writer, his assistant surgeon, was allowed to take charge of the case and to operate.

Upon examination, the patient was found to be a well-developed and nourished young man, apparently in perfect general physical condition. There was a distinct tumor mass at the point of the left shoulder, evidently arising from the humerus, some-

what tender, about as large as a man's fist, and somewhat fusiform in shape with undefined margins. There was almost complete loss of motion in the shoulder-joint, no glands could be palpated in the axilla. The pain from the growth was undeniably severe at all times. An X-ray photograph (Fig. 1), in fact more than one, was taken, and, although the plates showed almost beyond question a periosteal sarcoma of the humerus, the fact that the only operation to be considered was the very severe one involving the removal of the entire upper extremity, made an exploratory incision, to obtain a piece of the growth for microscopic examination, seem wise. All the surgeons who saw this case in consultation agreed in advising this; the patient himself refused operation until this proof was shown him. On the 28th of October, under ether anæsthesia, an incision three inches long over the tumor mass, parallel to the fibres of the deltoid muscle, was made, and it was found that the muscle was involved in the growth. Microscopic examination of the pieces of tissue removed showed undoubted giant-celled sarcoma.

A sharp reaction in temperature and pulse followed this diagnostic incision. The patient's temperature rose to 103° F. forty-eight hours after the operation, and his pulse to 120, and there was greatly increased pain in the shoulder, which extended down the arm into the hand. The increase in pain was very marked; for three days the patient was in great distress and looked very sick, after which the temperature and pulse came down to approximately normal, and the pain diminished to what it had been previous to the exploratory incision. There was no evidence of septic infection in the incision at this time or afterwards to account for the reaction. The wound healed by first intention. It was a matter of interest and speculation as to whether the reaction was not due to forcing into the circulation chemical products of the sarcomatous tissue, and possibly sarcomatous cells. The importance of not cutting directly into a malignant growth, and that in operations for the removal of carcinoma and sarcoma all cutting instruments should be kept away from the diseased areas to avoid metastasis directly caused by the surgeon himself, has long been recognized theoretically. In this case the exploratory incision could have, and possibly may have, caused metastasis and recurrence. This point will be taken up later when the pathological conditions found in the specimen

FIG. 1.—Skiagraph taken before operation.

are considered. A diagnostic incision, however, seemed justifiable and was demanded.

Removal of the arm with the scapula and the outer two-thirds of the clavicle, interscapulothoracic amputation, was done under ether anæsthesia on November 5.

The important points in this operation are, the control of the hæmorrhage and the prevention of shock from dividing the great nerve-trunks. Death from this operation will usually be due to shock, with or without hæmorrhage. It was shown in this case that shock could be prevented entirely by controlling hæmorrhage, so that practically no blood was lost, and by adopting the method of Crile and Cushing, of injecting a weak solution of cocaine into the large nerve-trunks of the brachial plexus before dividing them. It is known that one of the great factors in causing shock from surgical operations is the division of the great nerve-trunks, the brachial plexus, the sciatic and anterior crural nerves. Crile * has shown by his experiments and practical work, that if, before dividing the nerves, a few drops of a weak cocaine solution are injected directly into each nerve-trunk, the division of the nerves has no perceptible effect on the pulse-rate or volume. In this same connection Crile has shown that in operations upon the larynx painting the internal surface of the larynx with a solution of cocaine will prevent those unfortunate cases of fatal failure of respiration due to interference with the recurrent laryngeal nerve-fibres.

Cushing (ANNALS OF SURGERY, 1902, Vol. xxxvi, page 321) has written at length on prevention of shock in major amputations by the use of this method, and reported two cases of interscapulothoracic amputation in which he had used it with apparent success. The writer has had little experience with this use of cocaine aside from this case; it has been used twice by him in amputations of the thigh in cases in which moderate shock was present before the operation. In both cases the amount of shock was not added to by the operation. Lund

* Problems relating to Surgical Operations, Philadelphia, 1891.

(*Boston Medical and Surgical Journal*, April 16, 1903) has reported a case of this form of amputation for sarcoma of the humerus in which he followed out this method of Crile's, and in his opinion it was very effective. A careful search of the surgical records at the Massachusetts General Hospital shows that since 1870 this operation has been performed in but four cases in addition to the case described by the writer. In none of the cases is it recorded that this method was adopted. In one case of the four there is no mention in the records of shock; in the other three cases shock was profound. In one case, which died within a few hours after the operation, it may be assumed with fairness that the amount of hæmorrhage, because of the failure to secure the subclavian vessels, was sufficient to have caused the shock; in another case the patient was in very bad general condition from prolonged suppuration. The fourth case was apparently a very favorable one for operation; the hæmorrhage was well controlled, and there was apparently no reason for the condition of extreme shock which supervened towards the end of the operation requiring much stimulation and oxygen, except for the division of the nerve-trunks. It is noteworthy that in this case the trunks of the brachial plexus were cut twice; that is to say, after dividing the nerves the first time it seemed wise to the surgeon to cut them off again higher up.

The difficult part of this operation, and the part which took the longest time, was the ligating of the subclavian artery and vein preliminary to removing the extremity. It was made easier because the subject was not large and fat, nor was there any infiltration of the supraclavicular region with disease, so that the dissection was through normal tissues at this point. The method of cutting through the clavicle, leaving the inner third, was chosen because no reason was seen for adopting the more dangerous method of disarticulating the clavicle at the sternal joint. The middle third of the clavicle was divided subperiosteally, the underlying periosteum and subclavius muscle divided and pulled aside, and the subclavian vessels disclosed by careful dissection. It was found that much care was necessary in dissecting down upon the artery, which was covered by

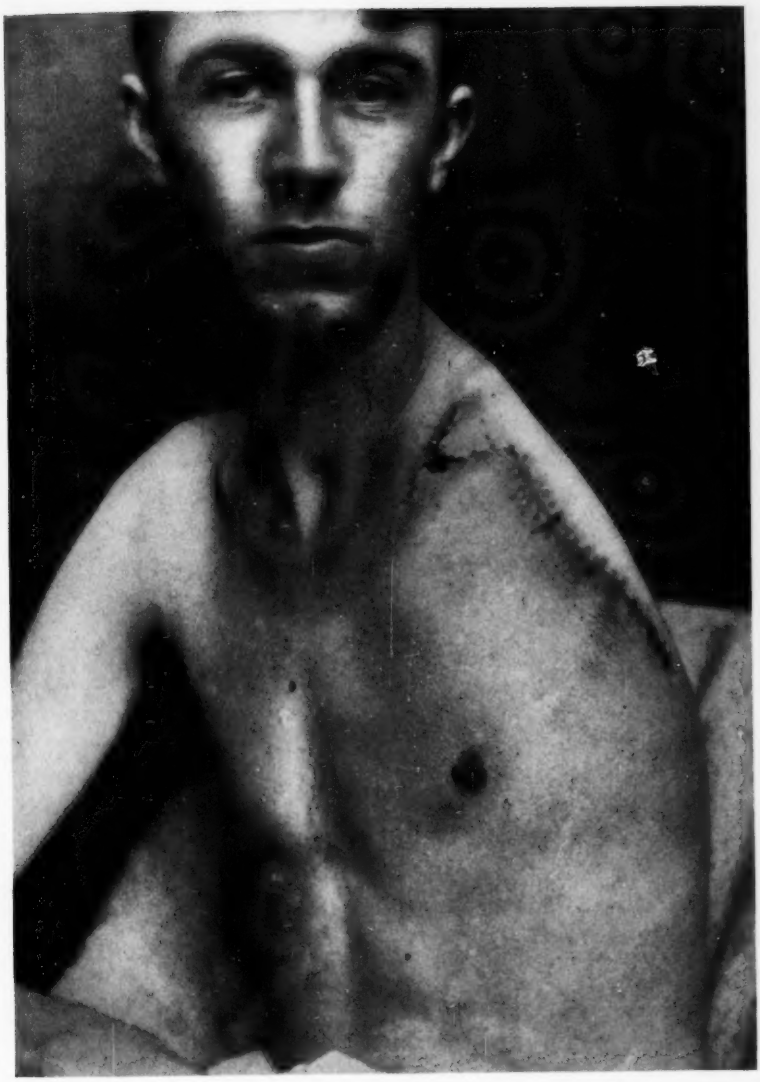


FIG. 2.—Photograph of the patient taken eight days after operation.

the subclavian and many smaller veins. The artery was ligated first with two strong silk ligatures and was divided between the ligatures, after which a third ligature was applied to the proximal end for increased safety. The arm was then elevated to empty it of blood, and then the vein was tied and divided. After ligating the vessels, the formation of the skin flaps and the division of the muscles were comparatively easy. The anterior and posterior skin incisions were joined at the root of the neck and at the bottom of the axilla. The pectoral muscles were rapidly divided, the trunks of the brachial plexus were injected with cocaine (Schleich's solution), and divided with scissors, after which the muscles attaching the scapula to the trunk were cut as quickly as possible. The suprascapular and posterior scapular vessels, the only blood-vessels of any importance to look out for after the subclavian had been secured, were readily seen and clamped. The skin flaps came together easily, were sewed with interrupted silkworm-gut stitches, and a small rubber tissue drain was placed in the lowest angle of the incision.

The patient was under ether one hour and fifteen minutes, thirty-five minutes of this time was consumed in the resection of the clavicle and ligation of the vessels. There was no shock whatever from this operation; the pulse remained at 80 throughout and did not change in volume at any time. The evening of the day after the operation the temperature rose to 100° F., but became normal the next day. The rubber tissue drain was removed in forty-eight hours. The patient made a complete and uneventful recovery, and on the fifth day was up walking about the ward. (Fig. 2.) The pathological report on the specimen was made by Dr. W. F. Whitney, and is as follows: "The left arm with scapula and clavicle removed together. At the upper part of the humerus, just below the head, was a new growth about eight centimetres in greatest extent, three centimetres in thickness, of a fusiform character, embracing the shaft and almost encircling it. Upon section it was grayish, homogeneous, with marked calcification and erosion of the cortical portion of the bone, and apparent extension into the medullary cavity, but without any destruction of the cortex. The circumflex vein was filled with a thrombus composed of new growth, which extended

as far as its union with the axillary vein, into which it slightly projected. A number of other small veins in the immediate vicinity were also thrombosed. There were numerous large, soft, axillary lymph nodes. Microscopic examination of the growth showed it to be composed of large round cells of irregular shape and size, mixed with many multinucleated ones. In places the tissue was extensively calcified. *Giant-cell sarcoma of periosteal origin with extension into the veins.* The lymph nodes showed simple hypertrophy, especially of the endothelial elements."

Before the operation, it was thought that this was a specially favorable case, inasmuch as the limited duration of the growth and its confinement to the humerus and deltoid muscle fostered the hope that recurrence would be long delayed; after finding the sarcomatous thrombi in the veins, however, an early return was feared. Eight months later the patient entered the medical wards of the hospital suffering from pleurisy with bloody fluid, beyond a doubt of malignant origin. The history as given in the medical records is as follows:

"May 31, 1904, Re-entry. P. I. Three months ago first had pain in the back; this disappeared but three weeks ago; he began to have a cough with white and at times bloody sputum, and severe pain in lower right chest. Pain worse on deep breathing and on coughing. Tapped three days ago and three and one-half quarts of bloody fluid removed, after which cough and pain became worse. Appetite poor, sleeps well, bowels constipated. Has lost but little strength, chief complaint is pain in chest.

"P. E. Well developed and fairly well nourished. Pupils equal and react. Tongue moist, heavy white coat. Teeth.—Upper false, remainder in fair condition. Pharynx somewhat injected. Glands palpable in right axilla. Amputation of left arm and shoulder with an irregular seven-inch scar. Heart.—Impulse and dulness correspond in fourth space half-inch outside nipple line. Right border half-inch to right of sternum. Action regular, sounds of good quality. No murmurs. Systolic thrill palpable at apex. Pulse regular, of good volume and tension, artery not palpable. Lungs.—Dulness, becoming flatness, with diminished vocal and tactile fremitus and breathing as high as the sixth rib

FIG. 3.—Picture of the specimen made soon after the amputation. Note the relation of the new growth to the scapula, the great blood-vessels, and the brachial plexus; note the sarcomatous thrombi in the subscapular vein.

FIG. 4.—X-ray photograph of the specimen; the humerus has been sawed vertically; note the different stages of the periosteal growth, also the invasion of the cortical substance.

front and back on the right with friction rubs and coarse râles above. Abdomen full, muscles held somewhat rigidly, tympanitic throughout except in epigastrium and right hypochondrium, where there is dulness; no masses or tenderness. Liver-dulness, upper border not made out, lower border one and one-half inches below costal margin in nipple line. Spleen not palpable. Reflexes present and normal. External genitals normal. No œdema. Temperature, 99.6° F.; pulse, 112; respiration, 28.

Hb.—80 per cent. Whites, 19,500.

Urine–n–ac–1028–alb=o (Sed. Few fat cells. Occ. squamous and cl–n U–3.28 per cent b.s.d.=o) large round cells.

"June 1. This A.M. complained of pain in left chest; on examination a marked friction rub was felt and heard in lower left chest in the side.

"June 5. Fluid in right chest is diminishing; friction rub in left side is nearly gone, and signs of fluid are disappearing. Feels and looks better.

"June 8. Friction rub disappeared. Feeling better every day.

"June 12. Right chest tapped this morning twice but no blood or fluid obtained. General condition unchanged.

"June 15. Two days ago developed a dry pleurisy in cardiac region; very painful. No rise in respiration or temperature. To-day it has nearly disappeared and patient feels very well.

Hb.—80 per cent. Whites, 9400.

"June 19. Anxious to go home. No more pleurisy or pain in chest. Discharged much relieved."

It is noteworthy that in spite of the widespread pleural involvement as evidenced by varying areas of pain, friction rubs, and abundant hæmorrhagic exudate, the patient improved greatly while in the hospital, and left comparatively free from pain and with no fluid in the chest. He was seen by the writer at this time, and was in good flesh, looking about as well as when he was operated upon. For over six months after the operation he stated that he had been, in his opinion, perfectly well and entirely free from pain.

The patient died from recurrence of the pleurisy and sus-

picious cerebral symptoms early in July, 1904, nine months after the operation.

It is disappointing to the surgeon to have in an apparently favorable case such a rapid recurrence with fatal termination. Such an outcome emphasizes the fact that no prognosis in regard to sarcoma can be made. Unfortunately, in the majority of cases operated upon, the disease recurs within twelve months, not locally for the most part, but in some more or less remote region. For seven months the young man was free from pain and mental worry, and was to all intents and purposes well; whereas, before the operation his suffering was very great both in mind and body, and the progress of the growth was rapid; this is sufficient justification for the operation.

Attention is again called to the malignant thrombi that were found in the circumflex and subscapular veins upon examination of the specimen; these can be seen in the illustration of the specimen. (Fig. 3.) At the time it was suspected that the presence of these thrombi meant that it was possible and probable that metastasis had already taken place into the venous system beyond, and, as was suggested above, it is not unsound reasoning to assume that the exploratory incision for diagnosis caused their formation.

The operation of interscapulothoracic amputation is considered to be one of the most radical of procedures. It should be the method adopted in most cases of malignant disease of the humerus, especially when the disease involves the tissues of the shoulder over the head of the bone. It may have to be done occasionally for malignant disease of the axilla, when the axillary vessels cannot be ligated without destroying the vitality of the upper arm; very rarely a surgeon will be called upon to perform this amputation in extensive injuries of the upper arm and scapula. Lund, of Boston, has had one traumatic case, which, however, did not survive the operation. It is rare that cases subjected to such severe traumatism are in sufficiently good condition to stand this operation.

Statistics cannot furnish an accurate estimate of the mortality of this operation when done for malignant disease of the

humerus. The character and size of the growth, the age and resistance of the patient, and the method of operating are factors which vary within wide limits. If the patient is in sound physical condition in other respects, and the growth is limited to the shoulder, with little infiltration into the tissues at the base of the neck, and if in the operation proper technical attention is given to the control of the hæmorrhage and prevention of shock, as described above, it is rational to feel that in the great majority of cases this operation can be done with safety, probably with just as much safety as amputation of the upper extremity at the shoulder-joint.

The control of the hæmorrhage is an all-important factor in this operation. The method which most speedily and safely exposes the third portion of the subclavian artery and vein always should be adopted. The operation as outlined by the writer is essentially the operation described by Berger (L'Amputation du Membre supérieur, etc., Paris, 1887). It is possible to enumerate as many as eight or nine different methods of controlling the hæmorrhage, as has been done by Le Conte (ANNALS OF SURGERY, 1899, Vol. xxx, page 260), several of them depending upon compression of the subclavian vessels with or without resection of the clavicle. Most of these are uncertain and unsafe. There are only three surgical ways to efficiently control the hæmorrhage, and of these three ways one, in the vast majority of cases, always is to be preferred. The artery and vein may be ligated without preliminary resection of the clavicle, after subperiosteal resection of the middle portion, or after disarticulation of the clavicle from the sternum, with removal of the entire bone. Le Conte has written at some length advocating the removal of the whole clavicle previous to securing the blood-vessels. His reasons for this are that it is needed to give the best exposure, and decreases the accidents of ligation. He thinks the method is quicker and easier than resection. The writer can see no reason for choosing this method, except in those exceptionally rare cases of large tumors with extensive encroachment upon the tissues at the base of the neck, in which it is doubtful whether by resecting the middle

third of the clavicle enough room can be obtained to safely expose the vessels, or in cases in which the clavicle is so involved in the disease that it may be more surgical to remove the whole bone. Whenever malignant disease has so extensively involved the tissues at the base of the neck and the bony substance of the clavicle as to require excision of the whole clavicle, it may be questioned with good reason whether any operation is advisable. Disarticulation of the clavicle at the sternal end must invariably be a more dangerous procedure than resection at the junction of the inner and middle thirds. The risk of wounding the innominate vein or the pleura is considerable; the attachments of the sternomastoid muscle will be weakened, and the deep fascia of the neck opened in all probability. In the writer's opinion, the method of choice in all cases in which operation is advisable is the subperiosteal resection of the middle third of the clavicle preliminary to ligation of the vessels and the ligation of the subclavian artery in its third portion before ligating the vein. This method will give room enough. In large, heavily muscled and fat individuals it may be necessary to divide transversely some fibres of the pectoral muscles. Lund, in his article referred to above, reports that this procedure was adopted by him with great advantage. If this is done, there cannot fail to be room enough for a safe and fairly rapid dissection, if the case is at all an operable one.

Among the cases at the Massachusetts General Hospital there has been found one case of advanced malignant disease, with a duration of many months, in which the extension to the soft parts of the base of the neck was marked. This case was operated upon; but upon resection of the middle third of the clavicle the surgeon was unable to find the subclavian artery, or to feel its pulsation, thereupon he adopted the method of making a posterior incision, turning up and forward the scapula and arm and clamping the axillary artery and vein at the very last of the operation under the anterior flap; this patient survived the operation but a few hours. In this case it may be questioned whether resection of the whole clavicle was not indicated; and it is in such cases as this, in the opinion of

the writer, provided operation is attempted at all, that disarticulation of the clavicle is necessary.

In one of the hospital cases, ligation of the subclavian vessels was done before resection of the clavicle; in the rest of the cases resection of the middle third was the method of choice. There is nothing to recommend the method of ligation of the subclavian vessels before resection of the bone. The field in which dissection is done is limited; after removal of the middle third of the bone, it must be easier and safer and can be done much more rapidly.

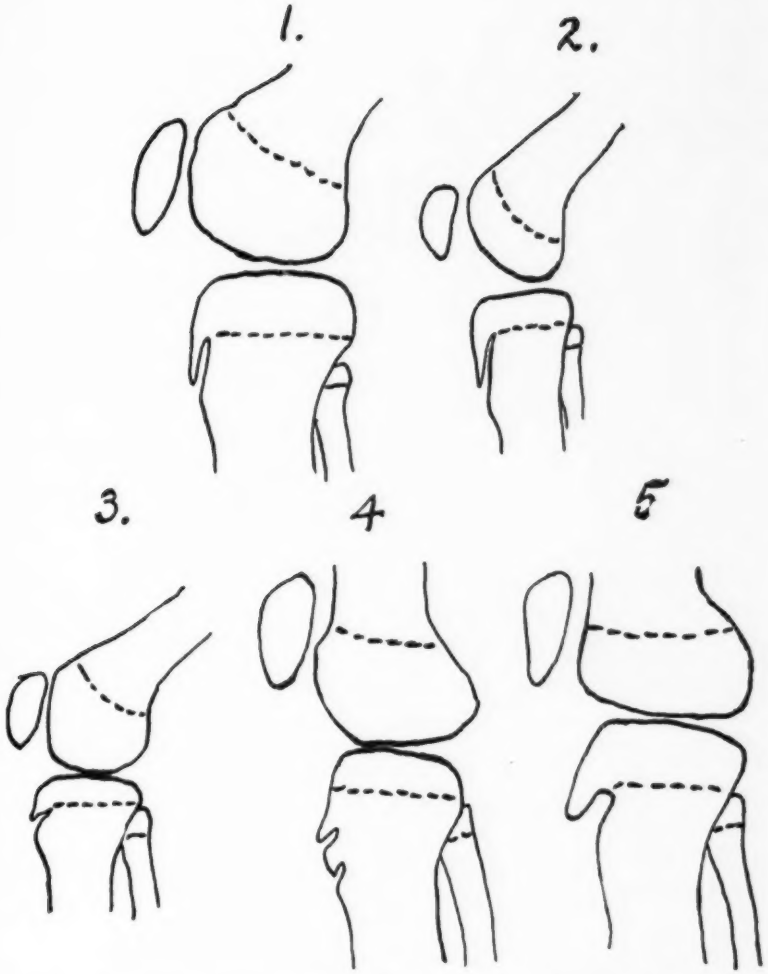
SYMMETRICAL INFLAMMATION OF THE EPIPHYSEAL BEAK OF THE TIBIA.

BY KENELM WINSLOW, M.D.,

OF SEATTLE, WASHINGTON.

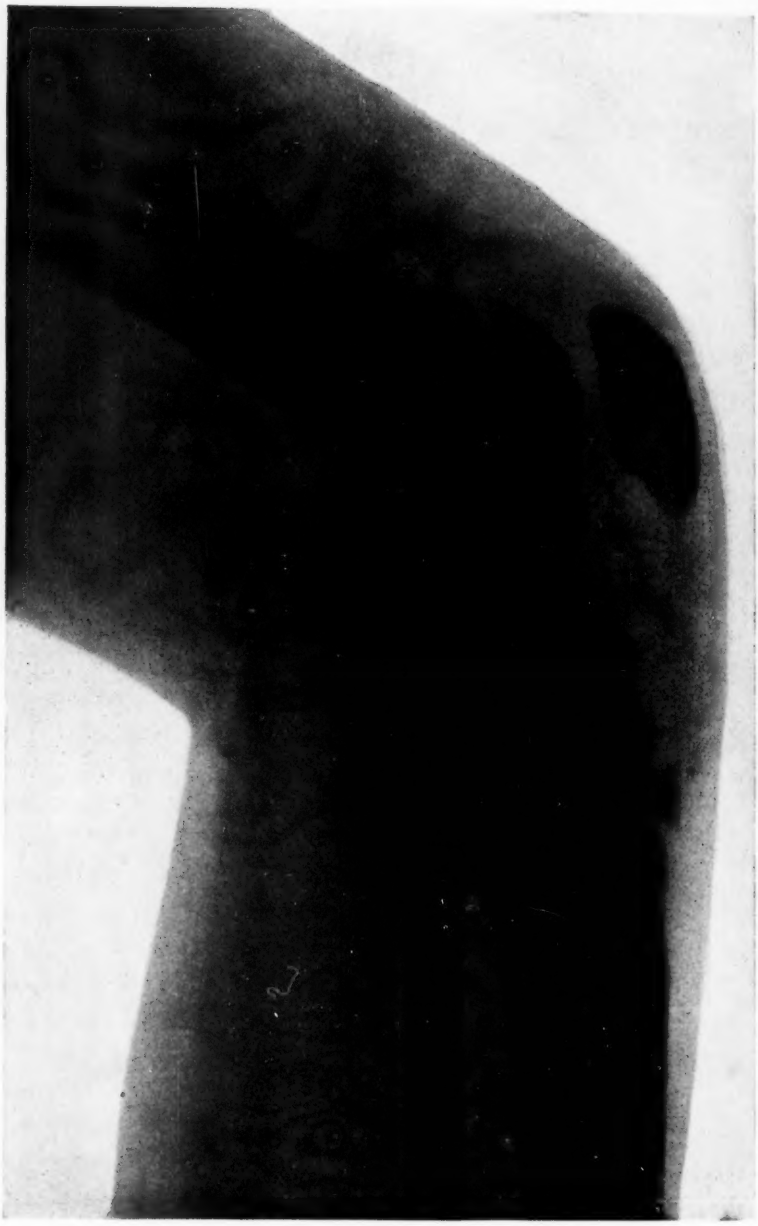
THE use of the X-ray has given us a much more complete knowledge of the nature and appearance of bones during the period of ossification, and in no instance has it proved of more practical interest than in the study of the development of the upper tibial epiphysis. Dr. Joseph C. Bloodgood, of Johns Hopkins, was one of the first to call attention to this subject in reporting the work of Schlatter (*Beiträge zur klinischen Chirurgie*, 1903, Band xxxviii, p. 887) in the December number of *Progressive Medicine*, 1903, and through his kindness I have been able to read Schlatter's original article. In the development of the upper tibial epiphysis there are two separate centres of ossification for the production of the tubercle of the tibia. One centre is formed at the site of the lower portion of the tubercle (Plate I and Fig. 4), and the other centre develops as a peculiar beak-like process which projects downward from the upper epiphysis. This beak is separated from the lower centre of ossification of the tubercle by cartilage up to the eighteenth to twentieth year, when the two centres become merged into one bony tubercle as it is seen in adult life. The lower centre of ossification of the tubercle does not appear until the twelfth year, and in Plate I, which was taken for the writer, of a healthy boy's tibia of twelve and one-half years, this lower centre is conspicuously evident.

Ludloff (*Ibid.*, p. 65) has also made a study of the development of the tibial epiphysis and the beak-shaped process, which will be discussed by Bloodgood in *Progressive Medicine* for December, 1904. Figs. 1 and 2 show normal tibiæ at the age of twelve, with the beak-like process of the upper tibial epiphysis; while in Figs. 3 and 4 are shown two centres of ossi-



FIGS. 1–5, showing outline in profile of knee-joints from skiagrams. Fig. 1 (after Schlatter), normal appearance of upper tibial epiphysis, and the same is seen in Fig. 2 (after Ludloff), at the age of twelve. Fig. 3 (after Ludloff), at age of fifteen exhibits both the beak-like process and the lower centre of ossification for the tubercle of the tibia in a healthy subject. Fig. 4 gives an outline of both centres of ossification somewhat different but normal. Fig. 5 (after Schlatter) illustrates dislocation of the beak-like upper centre of ossification forward, with separation of the cartilage between the two centres and enlargement of the beak from callous formation (boy of thirteen).

PLATE I.



Normal boy of twelve and one-half years; shows epiphyses and notably the lower centre of ossification of the tubercle. The beak-shaped upper centre of ossification for the tubercle is but faintly discernible.

fication of the tubercle, the upper beak-shaped process, and the lower centre of ossification projecting beneath it.

Schlatter's article refers to twelve cases following local injury to the knee-joints. In them pain, swelling, and tenderness over the head of the tibia were predominant, and not infrequently persisted for months, and even for two years, in one instance, and such cases are likely to be mistaken for traumatic arthritis in recent injuries, or for pyogenic or tuberculous osteomyelitis or new growth in more chronic conditions. X-ray examinations proved that Schlatter's cases resulted from dislocation of the centres of ossification of the tibial tubercle (Fig. 5), and when seen early, rest in bed, with fixation of the limb for two or three weeks, was usually sufficient to give relief from the trouble.

Schlatter found that in cases of long standing, while the disappearance of symptoms following this treatment was generally considerably delayed, yet it was safe to assure the patient of an ultimate favorable termination.

The foregoing premise is requisite to an understanding of the case herein reported, which seemingly simulates closely Schlatter's cases, although apparently differing from them in some minor respects.

May, 1904. Patient, a boy of fourteen years, with the following history: Family history good. Personal history irrelevant, except for scarlet fever in infancy. Two and one-half years ago he was attacked suddenly with fever, sore throat, and developed a rash upon the chest which was visible for but a few hours. Immediately after this there were pain and swelling in the joints, and weakness and irregularity in the heart's action, palpitation and dyspnœa, and a mitral murmur which persisted for nearly two years. The medical attendant at this time regarded the case as one of scarlet fever, but from the description and subsequent course of events, and the previous history of scarlet fever, it would seem as if a diagnosis of acute rheumatism might have been not improbable.

However this may have been, the boy was brought to me at the above date for trouble about the knees which did not com-

monly cause pain, but the knees were said to frequently "give way" and were very "sore." At this time there had been no pain or swelling in the joints for a considerable period, perhaps a year or more, and the heart difficulty had greatly improved.

The boy was thin but healthy looking, tall, and growing rapidly. Careful physical examination revealed nothing abnormal in the chest or abdomen except a movable kidney, from which his mother is a sufferer. The heart was apparently normal in size and position, and its sounds were clear, strong, and regular. On the anterior aspect of the upper epiphysis of each tibia there was a protuberance which, when seen from the side, bulged forward almost as far as the knee-pan above, and, although reaching up close to the lower border of the knee-joint, it did not invade the joint nor was the joint in any way affected.

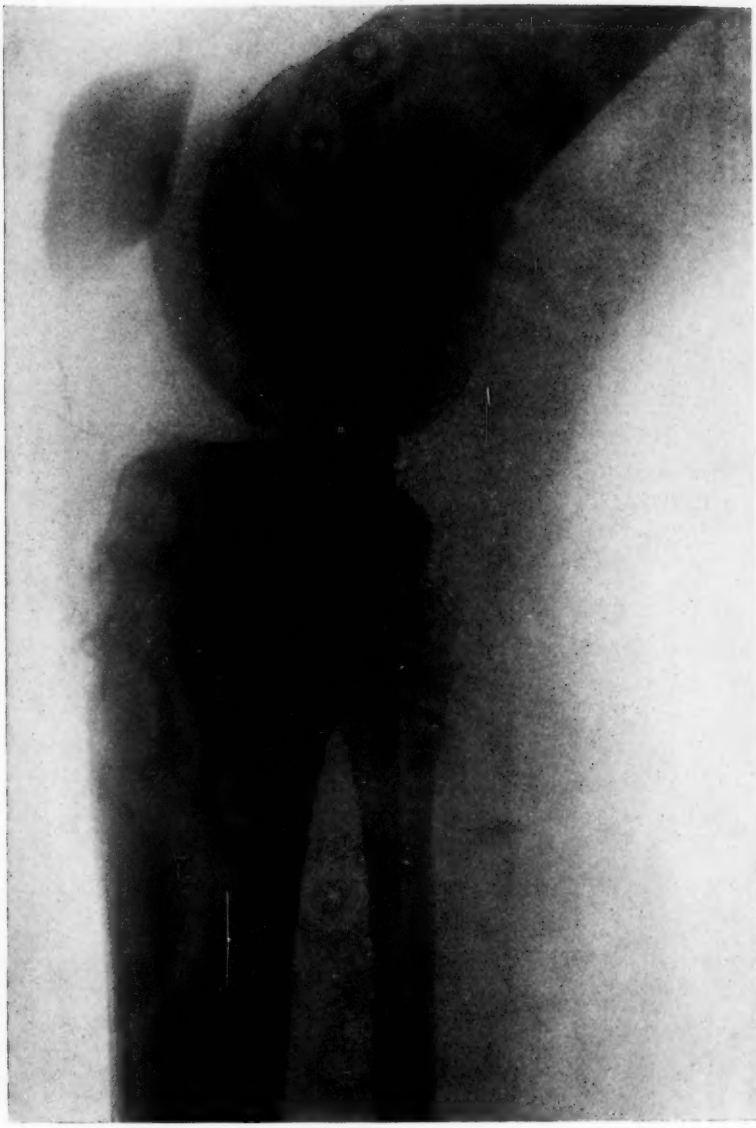
These swellings or tumors were very tender, somewhat abnormally warm to the touch, and of bony hardness, but the skin was not reddened. They gave no pain during motion or rest, unless the joint was violently jarred, or acutely flexed so as to bring great tension to bear upon the ligamentum patellæ which was attached to the inflamed area. The general bodily temperature was invariably found normal. The duration of the swellings was a mattter of doubt; they were not present when I examined the boy some months previous.

The two swellings were nearly identical one with the other. No history of traumatism could be discovered, but is it possible to eliminate traumatism in a boy? An X-ray examination revealed an erosion of the beak-like process of the upper tibial epiphysis of both legs, suggesting a rarefying osteitis associated with an ossifying periostitis (Plates II and III). In endeavoring to form a differential diagnosis, the following conditions were considered: an infectious or tuberculous osteitis or osteomyelitis, new growths, and traumatic inflammation of bone. Dr. Bloodgood, who was consulted by mail, brought to my notice Schlatter's cases and, to solve the diagnosis, advised operation. The absence of fever was unfavorable to the diagnosis of either infectious or tuberculous disease, and the existence of new growth was rendered unlikely on account of the bilateral character of the swellings. The use of tuberculin was considered, but was thought inadvisable as operation seemed indicated, and this, it was believed, would clear away the difficulties in diagnosis.

PLATE II.

Outline of right knee-joint of case reported displaying erosion of the epiphyseal beak and of parts just beneath.

PLATE III.



View of left knee-joint of case reported above. Erosion of epiphyseal beak of tibia, but not so clearly defined as in Plate II.

Rheumatoid arthritis was suggested, but the existing affection was clearly a bone disease, and did not at any time involve the joints.

After rest in bed, with fixation of the limbs on splints had been tried for a month, together with various other measures, as external applications of heat and cold, counterirritants, actual cautery, etc., without avail, the boy came to operation July 9, 1904. At operation there was found an area of softened, spongy, and much infected bone, perhaps as large as a silver quarter-dollar, covered with greatly thickened periosteum under the seat of each external protuberance at the head of the tibia. The softened diseased bone was scraped away to a depth of perhaps one-third of an inch and the periosteum and skin were approximated without drainage. There was no suggestion of any suppurative process. The wounds healed well without infection. Cultures taken from the scrapings proved sterile, and an emulsion of the same injected several times intraperitoneally into a rabbit gave a negative result. The scrapings did not afford suitable material for sectioning. The net result of the operation, therefore, was disappointing from a purely scientific stand-point in not elucidating the etiology of the inflammatory process.

Practically, however, the operation was a decided success. After the lapse of three weeks the patient began to go about, and a few weeks later there was a subsidence of tenderness and swelling, and the patient is now well. I am unfortunately unable to present a skiagram taken since recovery.

Some concluding remarks may not be amiss concerning this comparatively unusual condition. Apart from its injuries or diseases, the development of the tibial epiphysis is extremely interesting.

Gray says that one centre for the upper epiphysis appears at birth, and that there is formed from it a thin, tongue-shaped process in front which makes the tubercle, and adds that an additional centre occasionally exists for the tubercle. Schlatter, in his clinical studies, and Ludloff, in his investigations concerning the development of bones entering into the knee-joint, have determined the existence of two centres for the tubercle and their peculiar appearance seen in profile by means of the X-ray.

General skiagraphic work has brought to light the greater frequency of finer epiphyseal injuries, heretofore unknown; as for example, epiphyseal separation of the epicondyle or partial fracture of the lower epiphysis of the humerus; and it is not surprising that such a prominent and exposed epiphyseal surface, and therefore one so liable to violence, as that of the head of the tibia should suffer injury. Nor would it be unexpected for such injury to produce more than a single pathological state. So that what might be called Schlatter's disease, a condition described above and due to injury of the epiphyseal tubercle-centres of ossification, might fairly include a local osteitis in its pathology as well as fracture and partial dislocation of the ossifying centres.

A case not greatly dissimilar to Schlatter's is herein described, and, while it differs in certain particulars from his, it may broadly and not unscientifically be classed with them. The absence of a history of traumatism may be disregarded in the instance of an active, playing boy. The skiagrams, however, appear to unmistakably denote an inflammatory lesion about the tubercle-centres in my case, while there seems to be no dislocation of the centres or callous formation, as in Schlatter's cases, and the bilateral symmetry is not common to his.

In other words, the case described resembled Schlatter's in its clinical features, and, while there was no actual evidence of traumatism or dislocation of the tubercle-centres, yet it is not improbable that some slight injury, with or without a latent infection (as from that occurring two and one-half years before), had produced an inflammation of the tubercle-centres of ossification.*

* Since writing the above, the article by Ware, of New York, on Fracture of the Tibial Tubercle, has appeared in the November ANNALS OF SURGERY for 1904. Also the following references bear upon the general subject:

O'Donoghue. Avulsion of the Tibial Tubercle. Boston Medical and Surgical Journal, June 11, 1903.

Osgood. Lesions of the Tibial Tubercle occurring during Adolescence. Boston Medical and Surgical Journal, Vol. cxlviii, No. 5.

Poland. Traumatic Separation of the Epiphyses, 1901.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, November 7, 1904.

The President, HENRY R. WHARTON, M.D., in the Chair.

COMPENSATORY KNEE-JOINT BETWEEN THE TIBIA AND SEMILUNAR CARTILAGES.

DR. JOHN B. ROBERTS reported the case of a lady of middle age who some five or six years ago applied to him for treatment of a painful knee-joint. In early childhood the knee had been operated upon for what was probably tuberculosis. After a long period of treatment the joint had recovered, with a considerable amount of stiffness. As a result of this infantile disease, the limb had never fully developed, and was shorter than the normal extremity on the other side. Compensatory mobility of the pelvic joints had enabled the patient in adult life to walk with only a moderate amount of limp, notwithstanding the dissimilarity in length of limbs and the defective mobility of the knee. When the knee was examined by Dr. Roberts, he found the scar of an old operation on the inner side, and observed that movement was possible from the nearly extended position through about one-third the normal arc of flexion.

The patient had been treated for gout by various European physicians. He also for some weeks treated the painful knee as a condition due to lithæmia. Pain persisted, and interfered to a considerable extent with the patient walking up and down stairs, though it did not preclude a moderate amount of exercise. He finally concluded to open the joint, with the expectation of finding, perhaps, a floating intra-articular cartilage. Incision on the inner

side of the knee revealed the interesting condition which he desired to report.

The motion of extension and flexion, which has been mentioned, was found to take place, not at the seat of the normal motion of the knee-joint, but between the semilunar cartilages and the head of the tibia. The semilunar cartilages were firmly attached by bony adhesions to the condyles of the femur, as the result of a destructive inflammation of the cartilage, covering the ends of the femur, in infancy. He found no floating cartilage in the joint and no dislocation of the internal semilunar cartilage, which was the one exposed freely to view. There was no reason to suspect any such difficulty with the other cartilage. The synovial fluid was somewhat blood-stained, as though the condition giving rise to pain was a slight synovitis. The wound was closed, and, though some superficial infection took place, the final result was an improvement in the painful condition. The mobility of the joint was only slightly, if at all, lessened by the operation.

The case was reported simply to record an interesting pathological result of old tubercular inflammation of the knee-joint.

The method by which the condition arose is, however, easily understood. The semilunar cartilages became attached to the lower end of the femur by reason of inflammation causing erosion of the articular cartilage on the end of that bone. As a result of this occurrence in early life, a compensatory mobility was established between the semilunar cartilages and the head of the tibia by means of an increased relaxation of the ligamentous attachments.

TYPHOID PERFORATION SUCCESSFULLY TREATED BY MAKING AN ARTIFICIAL ANUS, WITH SUBSEQUENT INTESTINAL RESECTION.

Dr. J. Chalmers Da Costa stated that he had operated five times for perforation in typhoid fever. Two of the patients died very soon after the operation. In one, the perforation was not found at the time of operation; and necropsy disclosed it in the hepatic flexure of the colon. This case was reported by Dr. Herman B. Allen. The fourth patient lived eight days after the closure of the perforation, but afterwards died rapidly from

a second perforation. Necropsy disclosed the fact that the first perforation was completely healed. The fifth case, which he now reported, was the only successful one in the series.

The patient was a man thirty-four years of age, who was sent to the Jefferson College Hospital on the 26th of May by Dr. Godfrey. The perforation had taken place twenty-four hours before admission, and Dr. Godfrey had been unable to persuade the family to allow immediate operation. The patient was in the end of the second or the beginning of the third week of the typhoid fever.

On admission, the man's condition was bad, but not hopelessly so. There were marked evidences of peritonitis; severe tenderness in the lower abdomen, most marked on the right side; muscular rigidity; respiratory immobility; diminution of hepatic dulness; and a pulse of 118, with a temperature of $102^{2}/_{5}^{\circ}$ F. Operation was performed immediately, the incision being made in the right iliac region.

The moment the peritoneum was opened, fæcal matter welled out. A perforation that would admit the index-finger was discovered in the ileum, a little over two feet from the ileocæcal valve, and opposite the mesenteric border of the ileum. This perforation was closed in the usual manner with two layers of sutures.

Examination of the ileum on the proximal side of the perforation did not reveal any ulcerations that seemed liable to perforate. Between the perforation and the ileocæcal valve there were several ulcers on the point of perforating, one being at the extreme lower end of the ileum. To have inverted them would have destroyed the lumen of the bowel. The patient's condition was by this time absolutely desperate, and resection was not to be thought of, particularly as the situation of the ulcers would have made it imperative to resect a portion of the colon with a portion of the ileum. He therefore performed an enterostomy on the proximal side of the sutured perforation by Professor Bodine's method. He chose this method so that he might be able at a later date to readily re-establish the lumen of the bowel. After the performance of this operation, the belly was cleansed, strands of gauze were introduced for drainage, the abdominal wound was closed, and the patient was returned to the ward.

For two days the man's condition was absolutely desperate. On the morning of the second day after the operation, the temperature was still $96^{2}/_{5}°$ F. On the evening of the second day, the condition notably improved; the temperature rose to $98^{1}/_{5}°$ F., and the pulse dropped to 98. On the morning of the third day, the temperature was normal. Quantities of pea-soup stools passed from the artificial anus. During the next few days the temperature remained normal, the diarrhœa greatly lessened, and there was no pain or discomfort. Each segment of the intestine was washed out gently, twice a day, with normal salt solution.

On the 5th of June, ten days after the operation, the patient was suddenly seized with violent pain in the right iliac region; the pulse rose from 80 to 108, and the temperature to 101° F. The pain continued throughout the night; but in the morning, before breakfast, it was relieved, and fæcal matter was found to be flowing out along the outside of the proximal section of the bowel. It seemed evident that another ulcer had perforated on the proximal side of the artificial anus, not into the peritoneal cavity, but into the zone of adhesions. The day after the appearance of this discharge, the temperature and pulse fell to normal; and from this time onward recovery was uninterrupted. The patient gained distinctly in weight.

The evidences of typhoid rapidly disappeared after the first operation, nothing but the nature of the stools remaining to suggest typhoid when the second perforation occurred, ten days later. After the second perforation took place, there was not a symptom of typhoid; and the stools, although soft, became normal in character. It was considered wise to wait for a time before operating for the closure of the artificial anus. The patient had been through a severe crisis and was much exhausted; and, as he was gaining in weight and strength, the delay would be advantageous. The bowel was probably still in a dangerous state, and might perforate from slight pressure. Delay would permit the peritoneum to attain that resistance to infection which is the rule in a case of long-standing artificial anus. During this wait, the skin of the abdomen became frightfully inflamed and infiltrated, from the constant contact with soft fæces; and the utmost care in cleanliness and the employment of a rubber cap, as used in iliac colostomy, failed to amend this condition.

On the 21st of October, he operated for the closure of the artificial anus. It was evident that he could not use Grant's clamp, on account of the existence of the second perforation on the proximal side of the artificial anus, an opening that was still patent, as shown by the continued oozing of fæces up from outside the bowel. He opened the abdomen above and to the outside of the anus; felt his way with the fingers inside; removed the portion of badly infiltrated skin, and resected the artificial anus. The second perforation was observed about two inches above the opening of the proximal segment of the bowel; it had evidently not been into the free peritoneal cavity, but into the adhesions that had formed about the artificial anus. The distal segment of the bowel was very much smaller than the proximal, owing to having been so long out of function; consequently, an end-to-end anastomosis was not performed. The lateral method was selected, and was effected by simple suturing. When just ready to close the abdomen, it was found that the gall-bladder was enormously distended; consequently, a tube was inserted for drainage. It may be noted here that a bacteriological investigation showed the bile to be sterile. The patient went on to uninterrupted recovery.

Dr. John H. Gibbon had operated upon a perforating typhoid ulcer which was similar in many respects to the one reported by Dr. Da Costa. In his case there was an unusually large perforation. The perforation and ulcer involved so much of the caliber of the bowel that closure was impossible. A resection was done and an end-to-end anastomosis made. The patient died about thirty-six hours after the operation.

Dr. Gibbon was of the opinion that in cases such as this one it would be far better to surround the perforated bowel with gauze and establish thorough drainage. This he thinks would be better than withdrawing the bowel entirely out of the wound. If necessary, the bowel could be attached to the peritoneum by catgut. In cases of this kind, where the patient is in bad condition and where there has been considerable outpouring of intestinal contents, the performance of extensive operative procedures is not warranted, and the simplest treatment gives the best results. It is also thought that drainage of the intestinal contents through the wound is some protection against the perforation of other threatening ulcers.

Dr. James P. Hutchinson cited a case to illustrate the difficulty met with at times during attempted turning in of typhoid ulcers with subsequent fistula. The patient was a woman in whom perforation had occurred, the opening being about the size of a lead-pencil. The size of the ulcer and the condition of the bowel prevented turning in of the ulcer, and instead the thickened omentum was employed to cover the damaged intestine. The patient made a slow recovery, foul pus being discharged for some weeks. In this case Dr. Hutchinson believed a fistula existed, which eventually closed without operation. This result was accomplished by simply walling off the area of perforation with gauze. Dr. Hutchinson feels that recovery would not have followed turning in of the ulcer in this case as obstruction would almost surely have resulted. He employed resection in one case where there was an intussusception in addition to several perforations, one and one-half feet of the bowel being removed. The patient lived thirty-six hours, death being due to peritonitis. Dr. Hutchinson believes the patient's chances would have been better had the method used by Dr. Da Costa been employed in this case, or in any case in which resections may be necessary.

Dr. Robert G. Le Conte agreed with Dr. Da Costa that resection of the bowel is a most hazardous procedure when the perforation is so large that it cannot be closed by suture. He had done it once and lost his case. He did not, however, approve of making a formal artificial anus, as described by Dr. Da Costa, where other portions of the bowel were deeply ulcerated, as under the circumstances, should another ulcer perforate, a successful termination, as shown in Dr. Da Costa's case, will but rarely occur. Where the opening is large and other portions of the bowel seem seriously inflamed, he agrees with Dr. Gibbon that the safest plan is to wall off this area of the intestine with gauze from the general abdominal cavity. He had resorted to this expedient twice, and in both instances his patients recovered.

PERFORATED GASTRIC ULCER, FOLLOWED BY THE DEVELOPMENT OF AN ABSCESS BETWEEN THE LIVER AND STOMACH.

Dr. J. Chalmers Da Costa reported a case of perforated gastric ulcer in a girl of sixteen years. The perforation was en-

compassed by adhesions, and was followed by the development of an abscess between the stomach and the liver. In this case the diagnosis was extremely obscure, one suggested diagnosis having been tuberculosis and enlargement of the kidney. The patient had tuberculous consolidation of the apex of the right lung.

He referred to this case in order to show a deceptive skiagraph, which seemed clearly to show two calculi,—one, it might be thought, in the kidney, and the other in the ureter. He, however, followed a rule that he believed to be sound, that is that the clinical symptoms form the best guide; and accordingly he opened the abdomen, found and drained the abscess, and closed the perforation. On conducting a search to discover whether or not there was trouble with the kidney and ureter, he quickly found the cause of the deceptive skiagraph; there were two calcified colic glands. He had no doubt that such deceptive pictures had occasionally misled surgeons into operating for stone in the kidney when none existed.

Dr. John H. Gibbon referred briefly to two cases of perforated gastric ulcer which he had operated upon since his report of four cases made before the Academy about a year ago. The first patient was a man fifty years of age, who gave a typical history, and had the typical symptoms of gastric ulcer. He was seen twenty-four hours after the onset of acute symptoms. He then had a general peritonitis; the abdomen was scaphoid and intensely rigid. The diagnosis of perforated gastric ulcer was made and the abdomen opened. The peritoneal cavity was found filled with seropus. In the lesser curvature of the stomach near the pylorus was an indurated area supposedly marking the site of an ulcer, but there was no perforation. Opening of the lesser peritoneum revealed no perforation on the posterior wall. The duodenum contained no ulcer, and the appendix appeared normal. The abdomen was closed with drainage, and eighteen hours later the patient died. Post-mortem examination revealed an ulcer in the indurated area of the stomach; there was no perforation, nor even signs of threatened perforation, and there was no other ulcerated area in the stomach or intestinal tract. Dr. Gibbon believes that peritonitis was caused by the ulcer, without perforation. A second patient, operated on twelve hours after the onset of acute abdominal symptoms, had a perforation of the anterior

wall of the stomach near the pylorus. He lived four or five days after the operation. He had been a hard drinker, and died apparently from delirium tremens, as he manifested all the symptoms of that condition, and there was no evidence of spread of the peritonitis. This man had been treated for three years for gastric ulcer, and operation revealed adhesions between the stomach and liver; these probably had ruptured and allowed the escape of material which had been held between the two organs, thus giving rise to the acute peritonitis.

GASTRO-ENTEROSTOMY FOR ULCER OF THE ANTERIOR WALL OF THE STOMACH, NEAR THE PYLORUS.

DR. DA COSTA reported a third case in which an operation had been performed for ulcer of the anterior wall of the stomach, near the pylorus. He performed gastro-enterostomy, according to the method recently described in the ANNALS OF SURGERY, by Scudder, of Boston. In ease of performance and in perfect cleanliness, he found the operation most satisfactory.

After its performance,—that is, the day after the operation,—this patient vomited quantities of bile. The second day after operation, this condition still continuing, he was obliged to consider what he could do for the girl if it was not quickly arrested. Fortunately, however, it was arrested by frequently washing the stomach; but the development of the vomiting led him to think that a serious objection to Scudder's operation is that, should a vicious circle be formed, it could not be remedied by entero-anastomosis, on account of the bowel having been picked up too close to the duodenojejunal junction.

The following facts seem perfectly clear:

1. If a vicious circle exists after this operation, entero-anastomosis is impossible; and there is open only one of two methods: First, as was suggested by Dr. Francis Stewart, ligation of the pylorus; and, second, as occurred to him, the opening and drainage of the gall-bladder. This suggestion may have been made before, but he was not aware of it.

He did not know what percentage of the bile that comes down the hepatic duct is taken externally when the gall-bladder is drained, but certainly a great quantity of it escapes. If one could by this method remove a large percentage of the bile that

would otherwise enter the duodenum, one would thus intercept a great amount of the bile that would otherwise enter the stomach; and it seemed to him that this method of procedure should at least be thought of in any case of vicious circle. This patient, fortunately for her, recovered without the employment of either of these procedures.

It has been affirmed by some operators that the vicious circle does not occur after posterior gastro-enterostomy; but, personally, he believed that it may occur after any form of gastro-enterostomy, if the pylorus is open.

Dr. William L. Rodman regarded as most valuable the suggestion of Dr. Da Costa to drain the gall-bladder for overcoming the vicious circle following gastro-enterostomy. This sequel is not so apt to follow posterior gastro-enterostomy, but it does follow both the anterior and posterior methods, and perhaps more frequently than is generally admitted. One surgeon recently stated that a large number of his cases developed the vicious circle. Dr. Rodman is surprised that no one has before suggested the expedient mentioned by Dr. Da Costa, and in a future case he would not hesitate to employ it.

Dr. Robert G. Le Conte could not see that, in cases of vicious circle after gastro-enterostomyy, any advantage would be derived from draining the gall-bladder. Reasoning from analogy, where the gall-bladder is drained and no obstruction exists in the cystic duct, large quantities of bile will be drained off from the gall-bladder, but at the same time the color of the stools remains normal, showing that a considerable portion of the bile must escape through the common duct into the bowel.

In the vicious circle no obstruction to the common duct exists, and it did not seem to him that much would be gained by opening the gall-bladder and draining off the bile that enters that organ while the remainder passed freely into the intestine. Where the vomiting is obstinate after gastro-enterostomy, and is not relieved by washing out the stomach and the sitting posture, he believes the obstruction is generally due to adhesions, and nothing short of an exploration of the field of operation should be attempted.

Dr. Francis T. Stewart said he had been convinced of the plausibility of Scudder's operation which had been mentioned in the case reported. In two cases of gastro-enterostomy in which

he had employed this technique, the vicious circle was established. One patient died, the other vomited for days, and finally recovered after refusing a second operation. Dr. Stewart's intention in this case, had permission to operate been obtained, was to ligate the pylorus or some point near it. He does not believe that drainage of the gall-bladder would aid recovery in these cases. Scudder's operation differs from Moynihan's in location, being at the beginning of the jejunum, and thus rendering entero-anastomosis impossible.

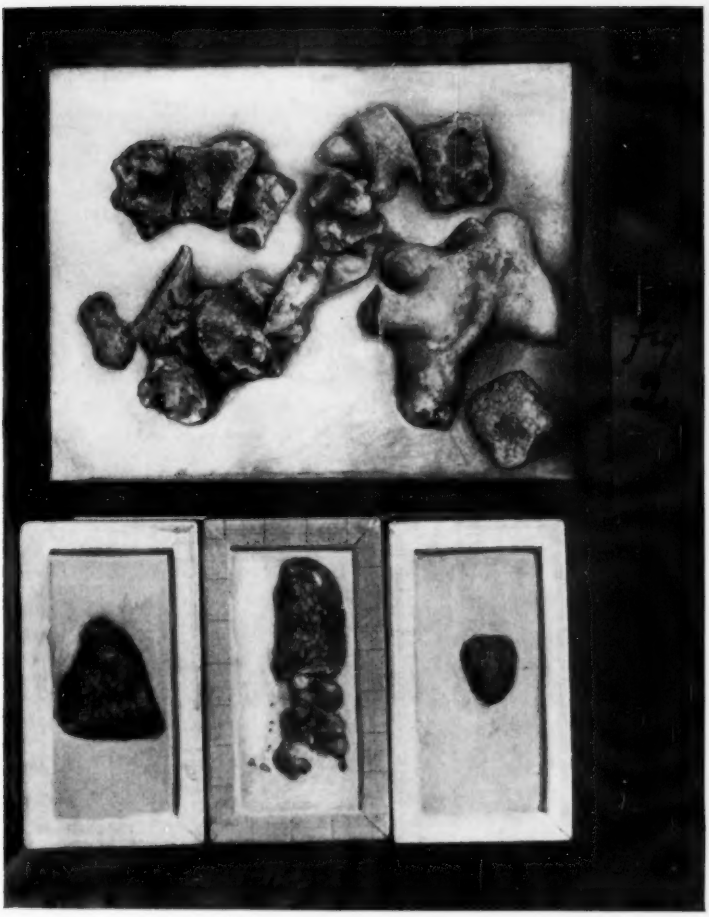
Dr. Da Costa, in closing, said that Dr. Le Conte had raised an important point regarding the utility of draining the gall-bladder in cases of vicious circle. Dr. Le Conte is of the opinion that only a part of the bile passes externally after draining the gall-bladder. This same point had occurred to Dr. Da Costa; but he thought that such a large amount passes externally that the stomach would be considerably protected by the procedure, for it seems to have been demonstrated that after every gastro-enterostomy some bile enters the stomach, and that a small amount of bile apparently produces little or no disturbance. The disturbance occurs only when there is a quantity of bile; and, by taking a large amount externally every day, one would certainly diminish greatly the amount that would be present in the duodenum and which could enter the stomach.

Dr. Da Costa, of course, recognizes the fact that the suggested expedient is a pure experiment, and might completely fail on trial; but he believes that, had the vomiting continued in the case reported, a trial of the operation would have been justifiable. Dr. Le Conte's objection that this would not prevent the intestinal contents from points further down from entering the stomach did not seem weighty to Dr. Da Costa, as he does not believe that in most of these cases any of the intestinal contents from farther down reaches the stomach. If it should do so, it would give evidences of its presence; and these evidences would, of course, contraindicate the operation of draining the gall-bladder.

NEPHROLITHOTOMY.

Dr. Gwilym G. Davis reported four cases in which he had removed renal calculi by incision into the kidney.

Case I.—Laborer, aged thirty-three years. Six years ago



Figures showing the calculi removed in Dr. Davis's cases of nephrolithotomy.

he had several attacks of what were probably renal colic. His present illness dates back five months. He contracted a heavy cold with cough, fever, and pains all over his body. During this illness he was seized with a sharp pain in the right lumbar region. It was localized and cramp-like in character. He was confined to bed for two days, and then went back to work and remained at it for a month. He then fell sick and indisposed, with sharp pain in the right lumbar region. He also had headache. The pain in the side lasted thirty-six hours, and then suddenly ceased, and there was a sensation as of something passing into the bladder. Since that time he had vomited a great deal, had some difficulty in urinating, and passed bloody urine. The urine stopped suddenly, but sounding failed to find any stone in the bladder. There was a skiagraph taken by Dr. C. H. Leonard, and, while the indications were not at all marked, he still expressed the opinion that a stone was present. Urine was sometimes acid, sometimes alkaline, and at others neutral. Sometimes it contained pus and blood. Specific gravity, 1018 to 1022; few bacteria.

Operation.—An incision about four inches long was made on the right side obliquely downward from the twelfth rib. The kidney was drawn out and the stone located by a needle. An incision about an inch long was made on the convex surface of the kidney, through which a triangular-shaped stone was extracted. (Fig. 1.) This incision was closed with four catgut sutures passed directly through the kidney with a round needle and tied with sufficient firmness to close the wound and stop the bleeding. The external wound was closed at each end and packed in the middle. In attempting the removal of the gauze, free hæmorrhage occurred. The packing was allowed to remain for several days longer, and was eventually removed, and subsequent convalescence was rapid and uneventful.

The first examination of his urine showed it to be red in color from blood. Specific gravity, 1018; alkaline in reaction; no crystals, but plenty of bacteria.

Ten days later it had a specific gravity of 1020, was pale straw color, faintly alkaline, and contained some pus-cells and bacteria as well as some alkaline phosphates. A still later examination gave a neutral reaction, no albumen, pus, or blood, and but few bacteria. There were some urates and uric acid crystals.

The calculus was heart-shaped, twenty-five millimetres (one inch) wide by thirty millimetres long, and about ten millimetres thick. An examination by Professor John Marshall showed that it was composed of calcium oxalate (mulberry calculus), and that it weighed 7.3 grammes (110 grains).

CASE II.—Young man, aged twenty-one years. He stated that a doctor had removed a stone from his bladder when he was four years old. Present illness began three and a half years ago with sharp, lancinating pain in the right lumbar region, extending as far forward as the mid-axillary line. For a year after this attack he felt well, when he had another, and then two more, two months apart, in which last one he had continuous pain for two months, when it ceased, and was absent for four months. The first of these attacks confined him to bed, and the pain was relieved by lying on the right (affected) side, while it was increased by lying on the left side. He has never had sick stomach, nor has the pain ever radiated down the ureter or testicle. On admission to the hospital he was a moderately well-nourished young man, sallow complexioned, with acne of the face. Pulse good, tongue normal; he complained of pain in the right side of the lower half of the chest and in the right lumbar region. There was tenderness on pressure, but no fulness. A skiagraph, taken by Mr. Riedel, showed a faint shadow about two inches from the median line and just below the costal margin. During the week previous to operation he had a slight chill, with temperature 100° to 101° F. Headache, coryza, slight conjunctivitis, and cough. These symptoms disappeared previous to operation. The urine was cloudy, yellow, with a dense white sediment; faintly acid in reaction; a few blood-corpuscles, and a marked trace of albumen. No casts, but an abundance of pus. Later it still continued turbid, contained pus, and its reaction became alkaline; it contained crystals of the triple phosphates.

Operation.—Under ether anæsthesia, a four-and-one-half inch incision was made down and out from the twelfth rib. The kidney was found much enlarged, capsule inflamed, thickened, and densely adherent. Kidney delivered with difficulty. A thin sac from three to ten millimetres (one-eighth to three-eighths inch) thick was all that remained of the kidney substance. This covered a large mass of stones, which were removed through an incision on the convex border. (Fig. 2.) The wound was packed

and drained. Recovery from the operation was prompt, there being but little shock. In the course of the week following the operation he had an attack of congestion of the lungs, which cleared up and the gauze packing was removed without difficulty. He passed from fifty-one to sixty ounces of urine per day, and the urea ranged from 1.9 per cent. to 2 per cent. The wound healed rapidly and was soon entirely closed, and, though the urine remained turbid, he seemed in excellent health, and later left the city. The calculus was composed of triple ammonium, magnesium phosphates, and weighed 953 grains, nearly two ounces or sixty-two grammes.

Case III.—This was a young married woman aged twenty years. Present illness. For the past four months complained of attacks of pain coming on at irregular intervals, but bearing no relation to the menstrual periods. The pain was described as dull and "pressing;" at times it was sharp, commencing in the right lumbar region and radiating to the iliac and umbilical regions and down the right leg as far as the knèe. No history of other attacks of renal colic. The pain was somewhat relieved by bending forward; vomiting occurs at times during these attacks. She had chilly sensations, but only one chill previous to operation. Was unable to bear the constriction of the clothing around the waist. She had had trouble with her urine for months. It dribbles away, and its passage was accompanied by straining. There was increased frequency of urination but no burning. It has been milky in color and ropy in consistency. No history of the passage of gravel or calculi. Urine, specific gravity, 1028; moderately acid; heavy trace of albumen. No casts; light amber in color, cloudy, and contained an abundance of pus.

On admission she was of a rather spare build, face flushed, tongue coated, abdomen not distended, no tumor discoverable. There was tenderness, not marked, in the region of the right kidney and right iliac fossa. A skiagraph showed a fairly distinct shadow indicating a probable stone in the right kidney. The urine previous to operation was acid in reaction. Specific gravity, 1013 to 1018; turbid; marked trace of albumen; dense sediment of pus. No casts; a few blood-corpuscles, and no tubercle bacilli. A later examination showed some hyaline and granular casts and bacteria in short and long chains. Some oxalate crystals

were found at times. The urea varied from 1.6 per cent. to 2.3 per cent.

Operation.—An oblique incision was made downward and forward from the twelfth rib and a stone ten by fifteen millimetres removed through an incision in the cortex. It weighed about two grammes, and was composed of oxalate of calcium, mulberry calculus. (Fig. 3.) The wound was packed, and on attempting its removal two days later the bleeding was so free that it was reinserted and left five days longer, when it was removed without further bleeding. The wound promptly healed and she was discharged cured.

CASE IV.—Married woman aged forty-four years. Present illness began two years previously with a sharp pain in the right side, at first this was intermittent, but later became constant. It radiated downward into the right groin. A skiagraph was made by Dr. Leonard, and he gave it as his opinion that a stone was present. Another skiagraph in another hospital failed to show the stone. An operation was done seven months ago and a large amount of pus evacuated from around the kidney and under the liver. Since this operation a sinus persisted in the loin, which led up under the liver and discharged large quantities of pus. The pains in the side still persisted of the same character and intensity. The urine was yellow, cloudy; specific gravity, 1022; acid; trace of albumen and an abundant white sediment. There were no casts. No crystals, but abundant leucocytes, no red blood-corpuscles.

Operation.—The sinus leading under the liver was slit up by following along the edge of the ribs and a very large amount of pus evacuated. The incision was then prolonged backward and the kidney exposed, and a stone of considerable size extracted. It consisted of calcium carbonate and triple ammonium, magnesium phosphates. It weighed 5.66 grammes (88 grains). (Fig. 4.) The wound was packed, and again there was troublesome bleeding before the packing was finally removed. Healing was rapid and the sinus closed in a little over a month's time.

Dr. Davis said that the question of diagnosis in cases of renal calculi is not always readily settled. In two of these four cases the presence of a calculus had not been previously recognized. Personally, his belief is that exploratory incision is justified when marked local symptoms point to kidney involvement. Probably

the best means of diagnosis is the X-rays, but even they are not absolutely conclusive. The value of an opinion depends largely on the personal skill of the examiner. In Case I the X-ray indications were not at all marked, yet Dr. Leonard expressed the opinion that a stone was present, and such proved to be the case. The stone was a good-sized one of oxalate of calcium, and should have given a good shadow. Case II likewise gave a faint showing, but Mr. Riedel claimed that it showed the presence of stone, and he was right; but the amount of calculus present was enormous, and should have given undoubted evidence. The fact that it was phosphatic in character may have been the cause of its not showing a stronger shadow. Case III had the smallest stone, oxalate of calcium, and threw a distinct, clear shadow, satisfactory in every way. It also was taken by Mr. Riedel. In Case IV Dr. Leonard had pronounced a calculus present, and another operator had failed to demonstrate it. The former proved to be correct. There can be little doubt but that in the hands of a skilled operator the X-rays will almost certainly show the presence of a stone if one is really there. Negative evidence is only to be accepted after repeated failures, and the positive evidence is to be interpreted by one accustomed to examine skiagraphs for the presence of calculi. The fact of all these cases involving the right kidney was worthy of note. It seems to show that the right kidney is more liable to calculous disease than the left, as well as more liable to dislocation. Recently a case came under his care in which the symptoms pointed to the presence of a renal calculus in which two skiagraphs were negative. Operation revealed an abscess of the kidney with no stone present, although small calculi had some time previously been passed from the bladder.

The urine in renal calculus is more often acid than alkaline. It may vary from time to time. In two of these cases it was alkaline at some period of the disease, but was most often acid. For part of the time it was acid in Case II, in which the whole kidney was blocked up with large masses of triple phosphates.

The presence of blood in the urine seems to be a reliable symptom. It was present in all the cases at some stage. In the first case there was a history of large amounts of blood coming away with the urine, but in the other three it was small in amount and only occasionally seen. Often it is only to be detected by

microscopic examination. Pain in the region of the affected kidney also showed itself quite a reliable symptom.

As regards the operative procedures, the incision used was an oblique one, extending from the anterior end of the twelfth rib downward and forward towards the anterior portion of the crest of the ilium.

This is preferred to the straight incision of Edebohls along the edge of the erector spinæ muscle because it can be extended both upward and downward if desired. Particular care is necessary in making the upper portion of the incision. The pleura crosses the twelfth rib about at its middle, or a little farther posterior; and if the incision is made up to the rib posterior to that point the pleura is liable to be wounded. The twelfth rib should be carefully identified, as, if it is short, it may be overlooked and the eleventh rib mistaken for it. Additional space can be gained if necessary by prolonging the lower end of the incision along the crest of the ilium. The question of bleeding may prove a serious one. That of the soft parts is readily controlled, and if the kidney is delivered externally the bleeding from it likewise can be checked. There is a temptation in these cases, when a stone is felt beneath the examining finger, to simply incise and lift it out with the forceps. In doing this the bleeding is apt to be exceedingly free and persistent, and only controlled with the greatest difficulty. For this reason no attempt should be made to either search for or extract a stone unless the kidney has been rendered accessible by drawing it out of the wound, or placing strips of gauze beneath each end. When it is once outside, an incision can be made in the convex edge just posterior to the median line and a digital examination made of its interior. After the extraction of the stone the wound is closed by three or four catgut sutures passed directly through the organ a half an inch or more posterior to the edges of the incision, with a round needle, and tied over the wound. This checks all hæmorrhage. While bleeding can be checked by packing forced into and on the kidney while it is lying in its bed, the procedure is dangerous and unreliable. Much blood will almost certainly be lost, and the patient is liable to be lost also. If packing has been resorted to its removal is likely to be followed by a renewal of the hæmorrhage, and it may be profuse. For this reason it is well to wait for several days and then inject peroxide of hydrogen to loosen

the gauze, and if it does not come away readily to allow it to remain until it becomes loosened of itself. It is well to put a rubber tube around each end of the kidney, securing them outside the wound, so that the kidney can be lifted up if necessary to control bleeding. These tubes can be taken away after the gauze has been removed and all danger of hæmorrhage passed. Healing in his cases had been prompt, and, though urine began to discharge externally almost at once, it ceased in a few weeks as the wound closed. It will take longer for the urine to clear, and it may remain turbid for a long while after the wound has healed and all calculous symptoms have disappeared.

Dr. Robert G. Le Conte said that in his first operative cases of renal calculus he was very greatly concerned about the hæmorrhage, which appears very alarming. As a rule, however, the hæmorrhage will lessen in a few minutes, or can readily be controlled by gauze packing. He did not fear to incise a kidney which could not be delivered through the wound, as he had seen two cases where delivery of the organ was impossible, and after incision the hæmorrhage was readily controlled by packing. If packing has been used to control hæmorrhage it should not be removed for a number of days, and then only after every precaution has been used to loosen it, namely, salt solution, peroxide, etc.

In answer to a question by the President, Dr. Le Conte said he had seen a renal calculus in a child under one year, the stone having been found at the post-mortem examination.

Dr. Henry R. Wharton, speaking of the age of subjects of renal calculus, said he had seen one in a child of nine years. The patient had an abscess of the pelvis, and after operation the calculus was discharged from the abscess cavity.

Dr. Davis, in closing, said the line of incision in opening the kidney should be at the point of anastomosis, of the anterior and posterior vessels, which is slightly posterior to the middle line. Regarding hæmorrhage, he felt a stone in the kidney in one case and thought it could readily be lifted out; he at once incised the organ and introduced forceps, which brought away only part of the stone, several trials being necessary to clean out the fragments. Hæmorrhage was severe, and he believes it would have been better to first secure control of the kidney before making attempts at extraction.

SARCOMA OF OVARY.

Dr. John H. Gibbon exhibited a solid ovarian tumor which he had removed the same morning. The patient was a woman fifty-two years of age, who had passed her menopause seven years. The duration of the tumor was said to be three years. The patient's abdomen was so distended with ascitic fluid that she was obliged to occupy a semi-sitting posture all the time. The tumor was easily palpable through the abdominal wall, and was quite movable. The tumor was easily removed, there being no adhesions. It involved the ovary only, the tube and broad ligament being entirely free from disease. A number of quarts of fluid were removed from the cavity. The patient recovered promptly from the operation.

The tumor was a large, rather elongated, irregular, lobulated mass, with a central constriction and a definite cavity large enough to admit an egg on the under surface. Its largest diameter was 20 centimetres by 1.3 by 6 centimetres. To one end was attached the remains of the Fallopian tube, which was quite small, and the tubo-ovarian ligament. The surface was quite smooth and practically free from adhesions. The tumor was mottled yellow, white, and pink. Large blood-vessels ran over the surface and a few small cysts were seen containing clear fluid. The margins of the cavity on the under surface were overhanging, rounded, and contracted in appearance; the cavity itself in places was lined by soft, yellow, stringy material. The tumor generally was exceedingly hard. On section, one received the impression that the main portion of the tumor formed a wall for the cavity, this wall averaging from two to three centimetres in thickness and was very firm in consistency. The cut surface was granular, irregular, and decidedly gritty to the knife, and was of a pale canary color streaked with white. At one pole of the tumor the wall gradually faded into a mass which formed the broadest portion of the growth; here the cut surface was quite granular, irregular, moist, streaked or mottled red, white, and yellow. The Fallopian tube was apparently normal. Weight, 800 grammes. A microscopic examination of the growth showed it to be a fibrosarcoma.

Dr. Warfield T. Longcope said the tumor was probably a carcinoma or an endothelioma. It is quite surely malignant now,

even if it did not start as a malignant growth. The shape of the specimen and the necrotic area in the centre suggest its origin from the wall of a corpus luteum, but such a diagnosis could hardly be ventured without further study.

DR. ROBERT G. LE CONTE said that the tumor shown was one of the most remarkable growths he had ever seen. He had never encountered a pure carcinoma of the ovary, although he had had several cases of proliferating papillomatous cyst. In these cases ascites was uniformly present, even when the malignant disease was confined to the cyst, and did not involve the peritoneum.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY.

Stated Meeting, November 7, 1904.

The President, L. L. McArthur, M.D., in the Chair.

THROMBOSIS OF SUPERIOR MESENTERIC ARTERY.

Dr. Louis A. Greensfelder reported the case of a man, aged forty-seven years, who entered the Michael Reese Hospital, July 23, 1904, at 6.30 P.M., with the history that no passage of fæcal matter, blood, or flatus had occurred for three days prior to admission; he could retain nothing by stomach; vomited colorless watery fluid; had severe sharp diffuse pain in abdomen; no chills; marked dyspnœa and prostration, and facies typical of a severe intraperitoneal lesion. Temperature, 98.4° F.; pulse, 88; respirations, 24. Physical examination of abdomen revealed a greatly distended abdomen. Percussion note was tympanitic, except in right groin and lumbar region, where it was dull. Palpation negative. No peristaltic wave to be seen or felt. Rectal examination negative.

Urinalysis.—Specimen obtained by catheter; quantity three and a half ounces, with a specific gravity of 1016. No albumen. No sugar. Trace of indican. No casts and a few leucocytes.

At 8 P.M. of the same day, under ether anæsthesia, a four-inch incision was made along the outer border of the right rectus. As soon as the peritoneum was opened, a large amount of bloody fluid without odor escaped. The appendix was sought for and found to be normal. Then a large loop of small bowel was seen to be discolored, and when brought into the wound eight and one-half feet (102 inches) of small intestine were found to be

gangrenous, which were clamped off, and again clamped off at the mesenteric border and removed. The mesentery was tied off with catgut, and the ends of the bowel approximated by a Murphy button. A Mikulicz drain was inserted; wound closed with silkworm-gut sutures, and dry dressing applied. Operation lasted two hours. Pulse at close of operation, 128.

July 24. Pulse, 88 to 100; temperature, 100° F.; respirations, 40. One involuntary bowel movement. Leucocyte count, 9000. Urine, two ounces, ss.

July 25. Pulse, 88 to 90; temperature, 99.6° F.; respirations, 36. One slight bowel movement. Hyaline and granular casts. Urine, four ounces.

July 26. Pulse, 84 to 88; temperature, 99° F.; respirations, 32. Five bowel movements. Urine, four ounces. Hyaline and granular casts.

July 27. Pulse, 76 to 84; temperature, 99° F.; respirations, 36. Two bowel movements. Urine, six ounces.

July 28. Pulse, 84 to 92; temperature, 102° F.; respirations, 48. Patient unconscious at 8.50 P.M.

Pulse began being imperceptible at 6. Expired at 11.15 P.M.

The pathological report on the organs after removal from body was: Thrombosis of superior mesenteric artery, with hæmorrhagic infarction of small intestine involving greater part of ileum; general arteriosclerosis, especially marked in abdominal aorta and its branches; fatty infiltration and hypertrophy of heart; chronic fibrous endocarditis of aortic valves and right ventricle; obliterative pleuritis of the right side; healed area (tubercular (?)), left lower lobe. Cloudy swelling and fatty infiltration of liver.

The aorta had on its intima numerous raised gray and yellow areas, irregular in shape, varying in size from a pinhead to a lima bean. On cross-section the change was apparently limited to the intima, which was greatly thickened. There was no ulceration or calcification. These changes were most marked in the abdominal aorta, where there were several hæmorrhagic areas and small clots adherent to the walls, in addition to the above plaques. The orifice of the superior mesenteric artery was almost totally obliterated by a firm red clot extending into the vessel. The right and left renal vessels were similarly affected, but to a less extent.

INTUSSUSCEPTION.

DR. L. A. GREENSFELDER reported the case of a man, aged eighteen years, who walked into the hospital, August 11, 1904. On admission at 3 P.M., the following history was obtained: Illness began six days ago, with a sudden, severe pain in the epigastric region, with nausea, vomiting, and constipation. Patient then consulted a physician, who prescribed castor oil, magnesia, etc., all of which the patient promptly vomited. During the first three days of the attack patient had a number of loose, watery bowel movements, with continual vomiting. The three days prior to admission was constipated. The pain in last few days become localized in the right iliac region. No chills, no headaches, cannot sleep, and has vertigo when he walks. Past history was negative. Never had a similar attack. No sickness of consequence.

Physical examination of abdomen revealed a tumor in the right iliac region. The abdomen was not tympanitic, and the tumor mass could be felt by rectum. Temperature, 98.8° F.; pulse, 114; respirations, 24.

Urinalysis.—Specific gravity, 1031; urea, 3.0 per cent.; no albumen; no sugar; indican present. Leucocytes few. No casts.

White blood count, 15,400 at 4 P.M.; 15,200 at 7 P.M. High rectal tube was introduced; no flatus was passed. He was given a low pressure enema, after which considerable blood was passed. Nothing was given by mouth, but rectal feeding of peptonized milk and beef peptonoids was given every six hours. Ice-bag to abdomen during first twelve hours. Temperature remained at 100° F.; pulse, 82 to 88. Had a slight bowel movement at 4 A.M. and 7 A.M., with flatus and considerable blood.

August 12. Temperature, 98.8° F.; pulse, 82; respirations, 24. Amount of urine in twenty-four hours, thirteen ounces. Urinalysis negative. White blood count, 12,600. One bowel movement at 9 P.M. and another at 10 P.M., both containing blood.

August 13. At 2 A.M. vomited considerable amount of brownish fluid. At 4 A.M. complained of severe pain in right iliac region; abdomen was slightly rigid; pulse, 84; temperature, 99° F.; respirations, 24. At 11.30 A.M. was taken to the operating room. Under ether anæsthesia, a four-inch incision was made along outer border of right rectus. As soon as peri-

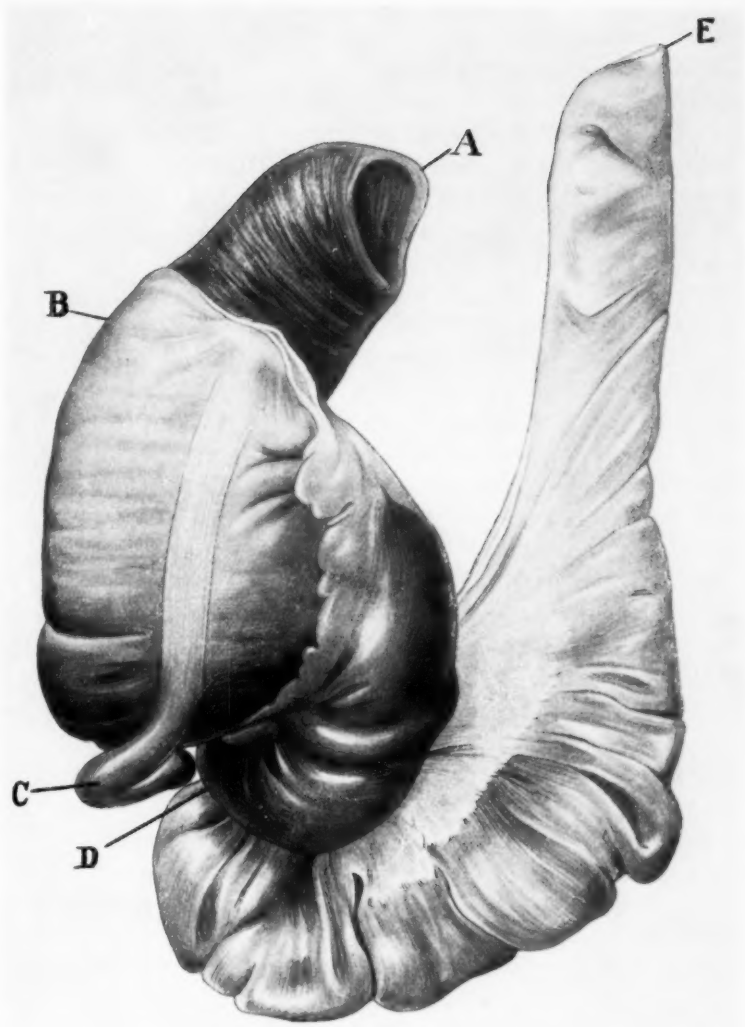


FIG. 1.—Intussusception. *A*, apex of intussuscipiens; *B*, cæcum; *C*, appendix; *D*, entering ring; *E*, ileum. Length of bowel resected, forty-six inches.

toneum was opened, an intussusception (Fig. 1) was found at the ileocæcal valve, and lifted out of the abdomen. The small bowel entered the large bowel for a distance of about six or seven inches. Bowel was found to be gangrenous for about three feet. The gangrenous portion, consisting of ileum and colon, was resected by clamping off the gangrenous portion with two clamps at each end and dividing between. The mesentery was clamped off and cut; all bleeding points arrested; the bowel was kept warm by the application of hot sponges, and edges of wound protected by gauze packing. The cut end of the colon was then closed by two layers of catgut sutures, one penetrating all the coats of the bowel and the second by a Lembert suture. Mesentery was next sutured. Repeated attempts were then made to place a purse-string suture around the cut end of the ileum and introduce a Murphy button, but the tissues were so friable that it was found impossible. The cut end of the ileum was then sutured to the abdominal wall, forming an artificial anus. Rubber tube was inserted into small bowel through artificial anus, and skin incision closed with silk sutures. A Mikulicz drain was inserted just below artificial anus, and dry gauze dressing applied. Patient put to bed in a very exhausted condition. Operation lasted two hours and ten minutes. A pint of normal salt solution was infused under each breast. Camphor in ether and strychnine sulphate were administered. Pulse, 164; temperature, 102° F.; respirations, 28. Dressings were saturated with fæcal discharges frequently during the first six hours.

August 14. Temperature, 103.6° F.; pulse, 120 to 140; respirations, 28. Forty ounces of urine were voided in past twenty-four hours. Urinalysis negative. Patient taking water, milk, and Vichy by mouth. Had a comfortable night. Considerable fæcal discharge through tube.

August 15. Temperature, 101° F.; pulse, 100 to 120; respirations, 24. Complains of cough. Drank coffee, milk, Vichy, and water. Twenty-eight ounces of urine.

August 16. Temperature, 100° F.; pulse, 96 to 100; respirations, 24. Patient has taken broth, milk, and Vichy.

Urine, twenty-two ounces. Urinalysis negative. Mikulicz packing removed, and one gauze drain inserted into wound. A number of bowel movements through artificial anus.

August 17. Temperature, 99° F.; pulse, 82; respirations, 22. Wound redressed three times. Urine, twenty-nine ounces.

August 18. Temperature, 98.6° F.; pulse, 84; respirations, 24. Urine, thirty ounces. Frequent changes of dressing were required.

August 19. Temperature, 98.6° F.; pulse, 80; respirations, 24. Patient taking rice soup, egg, milk, and tea.

Patient then continued with normal temperature and pulse, but on account of a severe dermatitis of abdomen and infection of skin edges of the wound, the second operation was delayed until conditions were more favorable.

On September 19, 1904, thirty-eight days after his first operation, the patient was again anæsthetized, and the following operation performed by Dr. E. Wyllys Andrews:

An incision about five inches long was made just to right of rectus muscle, beginning about an inch below costal arch, and carried through muscles and peritoneum. When intestines were exposed, it was found that extensive adhesions had formed between omentum and intestines. These were partly freed and the colon was brought into view. The artificial anus was obliterated by cutting the skin around anus and clamping ileum, which formed the anus. The part above clamp was severed and ileum ligated with strong catgut, and stump covered with Lembert suture. Then a portion of the ascending colon and ileum were brought into view and Lembert suture silk united their serous surfaces. Then incisions were made into colon and ileum, about one and a half inches long, and cut edges united by a Connell suture. The Lembert suture was now continued, and knot tied within lumen of bowel. The omentum was laid over bowel. Iodoform gauze drains were inserted at the site of the artificial anus, and peritoneum was closed with interrupted catgut sutures. Skin closed with silkworm gut and horsehair sutures. Dry gauze dressing applied.

Patient experienced no shock from operation, and following day temperature was 99° F.; pulse, 88; respirations, 20.

August 25. Had first bowel movement. Temperature and pulse have been normal since.

November 4. There is a very small fistula, which contains a drainage tube. Patient is up and in good condition.

Dr. E. Wyllys Andrews said that the matter of friability

of the intestine had been called to his notice in at least two cases, which seemed to be more analogous to a fat necrosis or some kind of degeneration than to peritonitis. In the case reported by Dr. Greensfelder great difficulty was experienced in bringing the intestine out and attaching it to the button, or even to the abdominal wall, by reason of the extreme softness. It would not hold stitches, and this mere mechanical difficulty prolonged the operation very materially. At the time the speaker saw the patient later, when a Connell suture anastomosis was made, there was no such trouble.

A similar case to this was reported to him by Dr. Morgan, in which the stomach wall was very friable. It was a gall-stone case, and in manipulating the gall-bladder gently the finger of the operator tore directly into the stomach, making a large opening. It not only tore as wet paper would tear, but it was impossible to suture with needle or even pick up the tissue with forceps afterwards. The slightest touch would tear through it. He never saw the stomach in that condition before. He attributed it to fat necrosis generalized over the adjacent organs. This was probably a case of pancreatitis, the generalized fat necrosis extending to and involving the stomach wall. He was quite sure that peritonitis alone, or mere hypertrophy and distention of the hollow viscera above a point of obstruction, could hardly explain the condition.

Dr. Albert J. Ochsner showed a specimen from a case of intussusception. The patient was a child, fifteen years of age, in whom a diagnosis of intussusception was made seven days after operating for an acute appendicitis. He thought the intussusception was about eight days old when a diagnosis was made, and that the appendicitis was an unimportant part of the condition for which the patient was operated first. In other words, the first diagnosis was wrong, at least so far as the serious condition was concerned.

Dr. Yates stated that about three years previous to admission to the hospital the patient was supposed to have had an acute attack of inflammation of the bowels. There were bloody stools, etc. The patient's recovery from this attack was rather rapid. The second intussusception took place in the ileum; the invaginated portion was fifty-two centimetres long. It had existed long enough for the intussusceptum to become gangrenous, so

that the intussuscipiens protruded through the wall of the intussusceptum.

Two days after the onset of the second attack, the patient was sent to the hospital by his physician with a diagnosis of appendicitis, which was confirmed and an immediate operation performed. Upon opening the abdomen, Dr. Ochsner noticed an excess of serum, which was the only feature not referable to the appendicular condition. The boy did not react well after the operation, and because of nausea received but limited amounts of water by mouth. This masked the symptoms by controlling peristalsis.

At the second operation, a week later, it was found that the gangrenous portions of the intussusception had been completely walled off from the general peritoneal cavity by adhesions formed by contiguous loops of intestine and the omentum and preventing a general peritonitis. The gangrenous portions had acted as a foreign body, produced a localized peritonitis which the absence of vermicular intestinal movements had allowed to become enclosed in the adhesions thus stimulated. On the twelfth day symptoms of obstruction reappeared, and an enterostomy was done for its relief. Death occurred the next day, with no evidence of a general peritonitis.

Dr. Jacob Frank said that about two years ago he reported a case of intussusception of the ileum into the cæcum in a child nine months of age, in whom he resorted to the use of the button, the child making a complete recovery. He showed the child before the Society one year after the operation.

With regard to sutures not holding when the intestine was friable, this was seen in cases of appendicitis when the intestine was œdematous. One could with difficulty get the sutures to remain in place without cutting through. In cases of intestinal disease in the acute stage where there was an œdematous or inflammatory condition, this was almost always found to be the case. He did not think it was due to pancreatitis or to fatty embolus. If it were, he thought we would have more deaths. He had found it in a large percentage of cases of appendicitis where the temperature ran high and where there was gangrene of the appendix.

Dr. D. A. K. Steele said that one point of interest in regard to the first case presented was the persistence of the intestinal

fistula, and whether that might not have been due to some foreign material retained in the abdominal cavity, or in connection with the inner end of the fistulous tract. Possibly the presence of the Connell suture might explain the persistence of the fistula.

With reference to the friability of the intestine and the difficulty of sutures holding, his experience had been the same as that of Dr. Frank. In many cases of acute inflammatory conditions of the intestine, particularly in appendicitis, and pustubes or infected tubes in women, there was great œdema of the adjacent parts, and the explanation given was correct, namely, that it was due to alteration in the wall of the intestine or tube from merely œdema. Dry paper did not tear easily, but if one would wet it, it would tear easily. The same thing could be said of the bowel wall in the same condition.

Dr. L. L. McArthur said that it was to Koenig that credit was due for emphasizing the fact that the bowel was friable above the seat of obstruction far beyond that which appeared to the naked eye, and venous septic thrombosis was liable to occur which would terminate fatally, although there may have been perfect suturing, the bowel being friable the nearer it is to the gangrenous area, although being vascular and its nutrition not being materially impaired. These cases he (Koenig) said would die in spite of perfect suturing from a septic thrombophlebitis in that portion of the bowel above, which had not been excised far enough beyond. It was a wise thing to go much farther above than appeared necessary to get a good suture field for the purpose of getting beyond a venous thrombophlebitis, which would scarcely show externally, but which would show when one saw the mucosa and submucosa of that portion of the bowel. Cases of mesenteric thrombosis were extremely rare, and were of considerable interest because of the great difficulty of making a diagnosis before operation. He had occasion to look up the literature in regard to this subject at one time, some years ago, in presenting a paper to the Chicago Medical Society, and could only find a record of two cases in which the diagnosis was made before operation. In the case reported by Dr. Greensfelder, that lived to the fifth or nearly sixth day, Dr. Greensfelder did not state from what the patient died, whether there was leakage at the point, or whether the superior mesenteric artery, which sup-

plied the entire small intestine and transverse colon, had produced gangrene beyond that portion which had been resected.

DR. GREENSFELDER, in answering the question of Dr. Steele, stated that there was no intestinal fistula at present.

In regard to the remarks of Dr. McArthur, in the patient who had thrombosis of the mesenteric artery there was complete gangrene extending not only to the small bowel, but to part of the colon, death occurring undoubtedly from this condition.

Regarding the statistics of mesenteric thrombosis, he stated that 217 cases had been recently reported by Jackson, Porter, and Quinby in *Journal of the American Medical Association*, with a mortality of 94 per cent. in non-operated cases, and a mortality of 92 per cent. in the cases operated upon.

PERINEAL PROSTATECTOMY.

DR. JACOB FRANK reported the case of a man, aged seventy years, who consulted him at his office, May 15, 1904, complaining of having been troubled with frequent and painful micturition for nine months, passing very little urine at the time; and after having had to resort to the use of a catheter several times at intervals during this period, had been compelled to lead daily catheter life for the past five months, suffering agonizing pains, insomnia, anorexia, unbearable pain in bladder, loss in weight, a great deal of residual urine,—quantity in twenty-four hours, fifty-eight ounces, specific gravity, 1023. Albumen present; no sugar; abundance of pus-cells; also some squamous cells; reaction acid; no blood; urea, 2.1 per cent. in twenty-four hour specimen.

Patient was sent to the German Hospital, May 29, 1904. He was put to bed; kept on a strict liquid diet; urotropin, five grains, every four hours; lithia water in plenty; boric acid irrigation of bladder daily at a temperature of 110° F., and the daily use of the prostatic catheter, as the ordinary soft rubber one could not be introduced; normal salt solution twice daily per rectum, as the patient was emaciated and required careful nursing.

The prostate gland could easily be palpated *via* the abdomen; the lateral lobes were greatly enlarged and very tender. The operation was performed June 2, 1904, four days after admission to the hospital, under chloroform. The patient was put in exag-

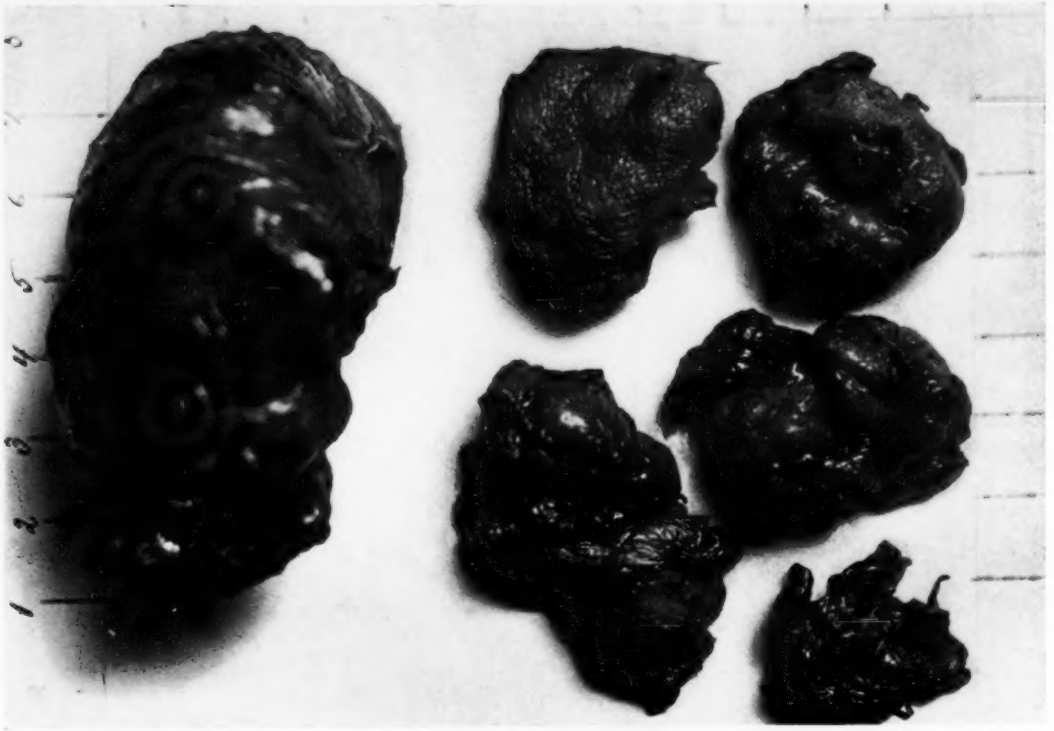


FIG. 2.—Prostatic fragments removed from the perineal route.

gerated lithotomy position; a grooved sound, to be used as a guide for a urethrotomy, was introduced into the urethra; an inverted U-shaped incision was made, the apex of which was taken just over the posterior part of the bulb, and the two arms, each about five centimetres long, midway between the anus and ischial tuberosities. After exposing the superficial muscles by blunt dissection, the central tendon was caught by a clamp near the bulb and divided; this freed the sphincter and levator ani from their anterior attachment, and exposed the rectum drawn forward by the recto-urethralis muscle. This muscle was then divided and the membranous urethra brought into view. This latter step not only exposed the membranous urethra, but prevented injuring the rectum, as shown by Proust. After exposing the membranous urethra, the muscles were retracted and the apex of the prostate was brought into view. The membranous urethra was then opened on the previously introduced grooved sound, and the edges retracted with transfixed silk retractors. A 30 French sound was then introduced through the incision into the prostatic urethra and bladder, and the sphincters dilated with a to-and-fro motion of the sound. The prostatic tractor, closed, was then carried into the bladder, while the edges of the urethral wound were held open by the silk sutures. As soon as the beak was free in the bladder, the thumb-screw, which fixes the blades in position, was loosened, the blades rotated by means of the external blades, and fixed by tightening the thumb-screw. The instrument was then handed over to an assistant, who made enough traction on the instrument to bring the gland into the field. Lateral retractors were now placed so that, together with posterior retractors and the traction produced by the tractor, the entire posterior surface of the gland was exposed. The capsule was now incised on each side of the median line for almost the entire length of the posterior surface of the prostate, the two lines being convergent. The bridge of tissue, as claimed by Young, contains the ejaculatory ducts, and hence the patient's potency was not impaired.

By means of blunt dissection, and with the aid of Young's forceps, the right and median prostatic lobes were enucleated piecemeal. The left lobe was enucleated *in toto*, measuring five by eight centimetres. (Fig. 2.)

The tractors were then withdrawn and a double drainage

tube introduced into the bladder through the opening in the membranous urethra, the inlet tube being about one-third the size of the outlet tube. This tube was fastened with a suture to the upper angle of the wound. The lateral cavities left by the enucleated prostatic lobes were packed with plain gauze, and the drainage tube connected with a siphonage arrangement, and continuous irrigation with normal salt solution, 110° to 120° F., thus kept up, the flow being regulated by means of a screw clamp in the inlet tube. The irrigation was commenced on the table to prevent blood-clots forming within the bladder.

On the second day after the operation the patient developed an orchitis on the left side, very likely due to extreme force used by the assistant, which was successfully treated with ice-bags and elevation of the scrotum. The rectal temperature for the first week ranged between 100° and 103° F.; pulse between 78 and 98. The temperature was due very likely to the orchitis, and also to the temperature of the irrigation fluid flowing so near the rectum. No shock; pain for the first two days relieved with one-quarter grain of morphia hypodermically. Two hypodermic injections in all were used.

On the second day the gauze packing was loosened, and some of it withdrawn every day until the sixth day, when all of the original packing was removed, and the superficial wound kept open thereafter with a small gauze pack.

The patient was allowed to sit up in bed with a back-rest on the fourth day. At the end of the week the continuous irrigation was stopped, and the drainage tube withdrawn. On the ninth day a 28 French sound was introduced through the urethra into the bladder, when a soft rubber catheter was carried into the bladder through the meatus, fastened, and the bladder irrigated twice daily with boric solution through this catheter. Five days later the catheter was withdrawn, no urine coming through meatus, as the perineal opening was yet too large. On the nineteenth day the patient passed some urine through meatus, but most through perineal opening. From this time on patient passed some urine, more every day, through the natural channel, and at the end of the fourth week most of the urine passed through the natural opening at intervals of every two hours.

With a 30 or 31 French sound his urethra was sounded every other day, and irrigated once a day after the second week.

In five weeks after operation, patient left the hospital with a very minute perineal fistula, which was dressed daily. At the end of the sixth week all was healed, patient passing urine every three to four hours, and quite clear. At the time of report the bladder did not contain any residual urine. He enjoys good health, eats and sleeps well, and has gained considerably in weight.

The man was impotent before the operation, and had remained so since.

Dr. M. L. Harris stated that ever since Young proposed this technique to preserve the ejaculatory ducts he thought much had been made of very little. These operations were nearly always done on old people, who, if they were not impotent, had passed the procreative age, or even the age when sexual intercourse was often indulged in, and so it never appeared to him to be a point of any great importance. Nor could the ducts always be preserved.

The method of approaching the prostate was not materially different from that employed by most surgeons when using the perineal route; in fact, after reading Young's description, he did not see anything in his method of approaching the prostate which could be claimed as new or original. So far as opening the capsule parallel to the urethra, or transversely to the urethra, was concerned, it was a matter of election or convenience in particular cases. Personally, he had opened the capsule transversely rather than longitudinally, but not across the mid-line. However, if he had found it facilitated the enucleation by making it in a longitudinal direction, he would have done it. His rule had been of late not to pack the capsule after removing the gland, but to suture it. He had brought the walls together by catgut sutures, and by doing this the period of convalescence was shortened.

Another point which he considered of importance was to get these old people up as quickly as possible after the operation. Old people did not bear the bed very well after operations. He therefore removed the perineal drainage very early and got the patient up. He had found the convalescence was much shortened in this way, not only so far as the patient's general health was concerned, but the perineal wound closed more quickly.

Dr. E. Wyllys Andrews did not think that Young himself

claimed as his the incision used by Dr. Frank, as credit for it belonged to Zuckerkandl. He agreed with Dr. Frank about the general improvement after prostatectomy. He had seen one or two old men who had had their testes removed, and one or two upon whom he had performed prostatectomy, who afterwards appeared to him to be ten years younger, in that the wrinkles disappeared from their faces, and they grew less sallow and withered or senile looking.

Dr. L. L. McArthur had had a fæcal fistula after a prostatic extirpation in one instance, and he thought caution might be well taken against the vigorous use of the median posterior retractor, in that it might cause a rectal perforation. He recalled a case in which it was easy to separate the rectum, and feel it fall back perfectly intact, and after the extirpation of the prostate, during which time the posterior retractor was used vigorously, when about to close the wound a small fistula was found riding astride the coccyx which had an unusually sharp anterior curve. The posterior retractor pulling on the coccyx tore a hole through and weakened the anterior rectal wall in that way. It had not gone through the posterior wall, but the anterior wall had been perforated. So caution should be used after the rectum had been demonstrated to be perfectly separated from the prostatic capsule to protect it against the action of the retractor faultily used.

Dr. Frank, in closing the discussion, said he did not claim anything new in the technique he had described; nor did he say that it was Young's method, but rather Young's technique. He had read the literature thoroughly, and he did not recall any one in this country or any other country who had described so nicely and so minutely what was being done. Out of ten surgeons who were doing prostatectomy, he ventured to say that six of them did not know what they were handling until they reached the prostate. They would tear around until they felt a hard mass, and then try to remove it. Personally, he liked to see every piece of tissue he was handling, and he was quite sure Dr. Andrews would not attempt to do one of his herniotomies without seeing every tissue he handled; consequently, he believed that surgeons were justified in doing prostatectomy upon the same principles and with the same technique as they endeavored to carry out in other operations on the human body. He

had seen prostatectomies, and he had done them, where everybody around was amazed at the flow of blood. It was unnecessary to transfuse patients if the technique of Young was followed. With this technique everything was under control of the eye, and one need not be afraid of a secondary hæmorrhage. He called anything surgery that one could see, and when he could detect every fibre and tissue he was working on. He did not call it surgery to take a knife in hand, jab it into the tissues, and then work in the dark, not knowing what he was feeling. No operation had pleased him more than when he did an operation on this case, because he had everything before his eyes clean down to the prostatic urethra.

He did not say anything about getting the patient up, but desired to say now that this patient was sitting up in bed on the second day. In the case of old men it was better to get them up as early as possible. He believed that this was generally accepted by all surgeons, that the earlier old men were gotten up the better it was for them.

GALL-BLADDER AND BILIARY-DUCT SURGERY.

Dr. D. A. K. Steele read a paper with the above title, for which see page 201.

Dr. A. J. Ochsner said there was no doubt whatever but what in the vast majority of all patients suffering from gall-stones, cholecystitis, or disease of the ducts, there was a time when the condition could be safely and permanently relieved by an operation, and that the serious conditions which the essayist had emphasized were the result of late conditions. A cholecystectomy would have to be made very seldom if an operation were done early. A choledochotomy would have to be performed probably never in case an operation were performed at the best possible time. Perforation of the gall-bladder, of course, would not occur. Peritonitis would not occur, so that whenever surgeons had an opportunity of impressing the internist with this fact, he thought they should do it. He thought also it should be done by securing the attendance of the internist at the operation, so that he can really see what was the matter inside of a patient, what the condition in the gall-bladder and in the ducts was at the time of the operation. If the internist saw enough of these

cases, he would soon learn not only to make a diagnosis of gall-stones, but he would learn to advise early operation. Even then it was not possible, because many of these patients would refuse operation, though urged by a man to submit to operation who had the conviction of a surgeon, so that it could not always be done. But the difficulty in these cases was this, that the majority of patients coming under the surgeon's care suffering from gall-stones had suffered previously from a diagnosis of gastritis. If there had not been the misfortune of this diagnosis having been made, the patient might have been relieved, but having had a diagnosis of gastritis or gastralgia made, the patient would continue to suffer from gall-stones because of the fact that he had been treated for the wrong condition.

In many cases suffering from cholecystitis, with the presence of gall-stones or sand in the gall-bladder, he had found the usual stomach symptoms, and upon examining the patient had found that the tenderness was to the left of the median line, while in a case of gastric ulcer, the greatest point of tenderness was usually exactly at the median line, although, in case the ulcer was in the greater curvature, or in the cardiac end of the stomach, then this was not strictly true. Now and then there might be vomiting of blood; there might have been blood in the stools; but the tenderness was to the left of the median line, so that a diagnosis of gall-stones was made. The typical point of tenderness between the end of the ninth rib and the umbilicus was also present; but upon opening the abdomen it would be found that the duodenum at its upper end was greatly distended, and that the pylorus was wide open. In cases of gastric ulcer the pylorus was closed, as a rule. When one lifted up the transverse colon and examined the small intestine, the jejunum, where it passes through the mesentery of the transverse colon, was contracted. It was empty, while the duodenum was open. Enlarged glands were found along the duodenum. This could only be explained in this manner, that there was a physiological obstruction opposite the entrance to the common duct into the duodenum, and for that reason the duodenum was distended with gas above and was closed lower down. In a large majority of these cases he had found either gall-stones or sand in the gall-bladder. Furthermore, in many of these cases he had found pancreatitis, due to physiological closure at a point behind the

stomach, a little below the entrance of the common duct. He would like to have other surgeons observe this condition in operating, namely, whether in many of their cases they find a dilated duodenum, a wide open pylorus, and a contracted jejunum down below.

Dr. D. N. Eisendrath said the more he saw of gall-stone cases, the more impressed was he that surgeons were apt to forget the complications on the part of the liver itself. In a paper read by him three years ago, to which the essayist had referred, he investigated, made sections, and cultures of a case that was operated upon by Dr. Greensfelder at the Michael Reese Hospital. In this case he found scarcely any of the liver cells stained, practically nothing but the inner third around the central vein. If one investigated the liver in cases of cholecystitis and gall-stones, varying degrees of liver necrosis as a result of infective cholangeitis would be found, where there was an associated cholangeitis, with or without pus formation, the more he was impressed in almost every case of gall-stones, in which there had been any perceptible degree of infection in the way of elevation of temperature, or chills, or leucocytosis, that there was considerable change in the liver parenchyma. How did this affect the prognosis? The liver was scarcely able, after a gall-stone operation, to excrete the normal amount of bile; it was not able to get rid of the many foreign substances which it ought to do, consequently there was that much more work thrown on the kidneys, and frequently after gall-stone operations patients became cholæmic. He saw a case recently of that kind. The patient became unconscious, began to vomit, and to have high temperature, and died within three or four weeks. These patients sometimes died from cholæmic symptoms, sometimes from symptoms of uræmia in addition to cholæmia; the cause of the uræmia being, in all probability, due to the fact that the kidneys are temporarily overworked by having too much excrementitious material thrown upon them.

Dr. M. L. Harris stated that since the surgeon had taken these cases under treatment, our ideas concerning gall-stones had materially changed. He would only mention a few points. First, gall-stones were always preceded by infection. They were due to infection. Gall-stones were therefore a secondary condition of the infection. He believed the infection, contrary to the gen-

erally accepted idea, was a descending infection. It was not due to the ascending infection, that is, organisms passing from the intestine up the bile duct, but due to a descending infection. The microbes were eliminated by the liver, and these gained access to the biliary passages.

Infection being the primary and chief condition, the surgeon operated to relieve or cure the infection. Gall-stones never gave rise to any trouble until they migrated or became restless. Every operation, therefore, should be accompanied or followed by drainage of the gall-tracts. The gall-tracts should be drained until the flow of bile was sterile. If one would make daily cultures of these infected bile-tracts, he would find that he would be able to obtain a culture up to a certain point and then fail. This is the only scientific time when drainage should be discontinued. Practically, it had been found that the bile would become sterile on an average in from ten days to two weeks; but one should continue drainage until he was no longer able to obtain a culture from the escaping bile.

Dr. Jacob Frank reported a case of infection of the liver. Recently he operated upon a patient for multiple abscess of the liver following appendicitis. Six weeks after the operation for appendicitis there was fever and other symptoms, and he suspected an abscess of the under or upper surface of the liver. On opening the abdomen, he took a culture from the gall-bladder, then punctured the liver, and took cultures from it. In the fluid, however, there were a few small flakes that did not look natural, but he did not know what they were. The patient died; a post-mortem examination was made, and multiple abscesses of the liver were found. The bile from the gall-bladder was sterile. He simply wished to ask this question. Why was the bile sterile in this case, and why was there not a descending infection? The aspirations taken from the liver were not sterile.

Dr. E. Wyllys Andrews believed that surgeons had over-estimated postoperative drainage as a curative measure. A statement of this kind as to the curative value of drainage was useful to surgeons in the class of cases on which they operated under mistaken diagnoses, and not having found any gall-stones, they could fall back on the theory of giving benefit to the patient by drainage. This was liable to be fallacious in his opinion, because it held a half truth. It was impossible to over-estimate the

value of restoring the drainage of the gall-tracts in a case of obstruction *per vias naturales*, but if this natural-tract drainage was restored, he was rather disposed to think, the more he saw of gall-tract work, that external drainage was needed only to save the peritoneum. It was known that a patient who had an obstructed deep duct and external drainage was secured alone, was only temporarily relieved, and after a moderate length of time would die of inanition if all the bile escaped from the fistula. In certain recent cases he had observed, instead of a marked and direct improvement following drainage, although jaundice was gotten rid of, there was slow exhaustion. Death did not always occur from peritonitis, uræmia, or from cholæmia, but from marasmus. He did not see how gall-stone surgery could help any patient except by removing mechanical obstruction to the flow of bile. It did not follow from that, however, that we did not need drainage; but we did, because it was a mechanical necessity after these incisions for a short time.

As to the remarks of Dr. Harris, that daily examinations would show less and less number or virulence of the micro-organisms, if it was true, as shown by Fütterer, that the normal gall-tracts physiologically contained living micro-organisms which were excreted by the liver and sent out through the intestines, he did not see that the point was of any particular value. In the last year he had come to look upon cholecystectomy as of less value than formerly. It might be he had over-estimated cholecystectomy in connection with gall-stone work; and possibly there were surgeons who were disposed to remove gall-bladder in a routine way the same as the appendix. Cholecystectomy was indicated in a certain class of cases, but in other classes of cases where the surgeon was in doubt as to whether or not to do it, it had been a distinct disappointment.

Dr. Steele, in closing the discussion, stated he had limited what he had to say to certain phases of the subject, and had then cited a few cases showing the bad results of late operations, and urging upon the Fellows the necessity of early operation. Although surgeons recognized the necessity of early operation in these cases, it was difficult to convince the general practitioner of its importance, even after early diagnoses were made. As the *Transactions* of the Society were read by a large number of general practitioners, he hoped the discussion would be of service

in helping them to make earlier diagnoses and refering their cases to surgeons for early operation.

There were many moot points connected with the subject of surgery of the bile-tract. He was familiar with the experiments that were made by Fütterer some years ago, showing the rapidity with which micro-organisms, when introduced into the blood, were found in the bile and passing down into the intestines; yet his personal experience had been so strongly along the lines indicated by Dr. Harris, he thought patients were not safe until bile became sterile, and he therefore drained every case,—at least, he drained more now than he used to do in these cases. Formerly, it was thought the ideal method was to close the gall-bladder after the removal of the gall-stones, but those patients did not do as well as those patients that were now treated by drainage. Where we had a dilated and infected common duct, or where we had gross pathological changes in late cases, drainage was absolutely essential, and must be continued for a longer time; and if one attempted to close the gall-bladder, as was done in the earlier operations, the patients would not do as well as they would where external drainage of the infected bile was resorted to, and drainage of a portion of the infected bile down into the duodenum.

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